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ABSTRACT

This publication includes more than 470 abstracts of papers scheduled to be presented at a chemical education conference. Topics of the papers include: (1) human impact on the environment; (2) technology; (3) forensic science; (4) paper chemistry; (5) computer interfacing, software, videodisc and graphics; (6) faculty enhancement programs; (7) textbook reviews; (8) courses for non-majors; (9) problem solving; (10) instrumentation; (11) acquired immune deficiency syndrome drugs; (12) plastics and polymers; (13) recruitment of chemistry majors; (14) nuclear and radiochemistry; (15) teaching mthods in organic and inorganic chemistry; (16) advanced placement chemistry perspectives; (17) microscale laboratories; (18) microscopy; (19) cultural diversity in chemistry; (20) demonstrations; (21) teaching high school chemistry; (22) geochemistry; (23) science education research; (24) cosmic chemistry; (25) museums; (26) middle/high school teacher education; and (27) learning styles and misconceptions. The conference program is included; papers are numbered in sequence as they are listed in the program. Each entry contains the title of the paper, author's name and mailing address along with a one-paragraph abstract. An author index is included. (KR)

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11th Biennial Conference on Chemical Education

August 5-9, 1990
Atlanta, Georgia

ABSTRACTS

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11th Biennial Conference on Chemical Education
August 5-9, 1990
Additions and Corrections to Abstracts and Index

The following index entry should be corrected: Baum, S. J. 465

The following papers have been withdrawn since printing deadlines:

052	Baker, Pribush	337	Warnock, Bent
123	Averill	348	Rosenfeld, VanDyke
145	Akeroyd	364	Shaner
274	Feldman	375	Baker
275	Akeroyd	381	Flath
280	Shaner	392	Chabay, Ullensvang
300	Escalera	448	Flath

The following abstracts have been added to the program since printing deadlines:

479 Black, Kersey A.
480 Borgford, Christie; Key, Mary Beth; Marsden, Alan; Waddington, David.
481 Bernier, U. R.; Williams, K. R.
482 Tornquist, Wade.
483 Kapuscinski, B. P.
484 Spencer, Bertrand; Zare, Richard.
485 Hildenbrandt, Jan; Mitchell, Donald J.; Spicher, Thomas A.

479 MICROCOMPUTER INSTRUCTION IN PROTON NMR SPECTRA INTERPRETATION. Kersey A. Black, Joint Science Center, Claremont McKenna, Scripps and Pitzer Colleges, Claremont, California 91711.

Proton NMR spectroscopy is the mainstay of organic qualitative analysis, and as such receives considerable attention in introductory organic chemistry courses. Software has been developed which helps exercise the users ability to correlate proton NMR spectra with molecular structure. The user can design and create organic structures on the screen of a Macintosh™ microcomputer using the mouse to select from a palette of molecular pieces. Alkanes, alkenes, aromatics, halides, alcohols, ethers, ketones, aldehydes, acids, esters, amines, and amides can all be easily constructed in this manner. The program then generates a simulated proton NMR spectrum using empirically based rules for chemical shift calculation and assignment of coupling constants. Any of several common field strengths are possible, and the spectrum can be expanded, scrolled, and integrated. Correlations between protons and signals in the spectrum can be revealed, along with a "splitting tree" showing the results of spin-spin coupling for a particular signal. Files of compounds can be created and stored on disk such that the structure can be either "known" or "unknown" to the user. The simulation provides a spectrum reflecting first- and some second-order effects. Multiple spectra can be displayed in separate windows.

480 CONTEXT: SCIENCE TEACHING IN ENGLAND. David Waddington, Alan Marsden, Christie Borgford, Mary Beth Key, University of York, Dept. of Chemistry, University of York, Science Education Group, Heslington, York, YO1 5DD, England

Teaching materials produced by teams of classroom teachers, chemists and science educators in England are activity and lab-based and tied to the context of the real world. Student and teacher interest is high when experiencing such science as percent water in "slimmers" margarine, making alloys for special uses and designing appropriate symbols for vehicles transporting chemicals. Advanced-level chemistry concepts arise from real-world problems. Criteria are tied to the British National Curriculum and materials are presented as lesson designs with ready to use student activity guides. material originated with funding from the Salters' Foundation and, thus, is known as Salters' Chemistry and Salters' Science.

481 POLYMER END-GROUP ANALYSIS IN THE QUANTITATIVE ANALYSIS LABORATORY. K. R. Williams and U. R. Bernier, Department of Chemistry, University of Florida, Gainesville, FL 32611-2046.

Beginning analytical laboratory students are introduced to the concept of number-average molecular weight via an experiment on end-group analysis of poly(ethylene glycol). The hydroxyl groups are esterified by reaction with a known excess of 1,2,4,5-benzenetetracarboxylic dianhydride (pyromellitic dianhydride, PMDA) in DMF using imidazole (IMDA) as the catalyst[1]. After the reaction the remaining anhydride is hydrolyzed and the carboxylic acid residues are titrated with standard base. The esterification reaction is complete in about 30 minutes at room temperature, and the subsequent hydrolysis is very rapid. There is a problem in some samples with precipitation of the salt of PMDA and IMDA, and methods to avoid this side-reaction are being investigated. Student results for several molecular weight distributions will be summarized in the oral presentation.

[1]Kingston, B. H. M.; Garey, J. J.; Hellwig, W. B. Anal. Chem. 1969, 41, 86.

482 USING HPLC IN INSTRUMENTAL ANALYSIS. Wade Tornquist, Department of Chemistry, Eastern Michigan University, Ypsilanti, MI 48197.

HPLC simulates a binary gradient high-performance liquid chromatography instrument and includes sophisticated modeling of reversed-phase column behavior. The modeling provides realistic chromatographic output over a broad range of operating conditions. The program has been used as a pre-laboratory exercise for students who will later be using the real instrument, and also to extend the range of experience available to students after they have interacted with the real instrument. In particular the program's computer data station provides better data analysis than most teaching instruments are capable of. Sample exercises carried out by students will be available to participants in the symposium.

483 IMPROVING THE SUPERVISION OF PRACTICE TEACHERS IN CHEMISTRY

B.P. Kapuscinski, Faculty of Education, University of Regina, Regina, Sask., S4S 0A2

Practice teaching is an essential component of chemistry teacher education. This presentation is a report of an ethnographic study in which practice teachers and their supervisor met regularly to reflect on the improvement of the practice teaching experience. The report includes recommendations dealing with role clarification, personal relationships and ways of integrating science, technology and societal issues into the chemistry curriculum.

484 USING THE HELIUM-NEON LASER TO ILLUSTRATE CHEMICAL PRINCIPLES. Bertrand Spencer, Richard Zare, Department of Chemistry, Stanford University, Stanford, CA 94305

Rayleigh scattering and directional scattering (diffraction) are two aspects of light interacting with matter that allow important information to be gathered concerning structure at the atomic level or molecular level. Tremendous contribution to science is made in these areas every year. It is felt that students should have some knowledge of these powerful techniques and their results. Therefore we present several experiments and demonstrations that involve diffraction and light scattering. Although the diffraction experiment involving polystyrene latex has been extensively studied its potential as a teaching technique is untapped. Certainly most would agree that to demonstrate molecular structure directly to students is difficult. Optical diffraction from polystyrene latex is one of the few ways to approaching this. Light scattering techniques are equally important as a means of determining size, shape and motion in solution. An experiment is introduced that uses static light scattering to measure particle size.

485 A PROVEN NETWORK AND SUPPORT SYSTEM FOR HIGH SCHOOL CHEMISTRY TEACHERS

Donald J. Mitchell and Thomas A. Spicher, Department of Chemistry, Juniata College, Huntingdon, PA 16652; Jan Hildenbrandt, State College Area High School, State College, PA 16801.

Since 1985 Juniata College Chemistry Faculty have been working closely with the Central Pennsylvania Association of Chemistry Teachers (CPACT), a highly motivated, self-help group of chemistry teachers from high schools in rural central Pennsylvania. With funding from NSF, Juniata College, and the private sector, a comprehensive support system has been developed for these teachers. This support system has had significant impact on the classroom activities of the teachers and their students. The various aspects of this program, which includes (1) a 16-foot box van, driven by a certified chemistry teacher, which transports equipment such as uv-vis and ir spectrophotometers, gc, hplc, pH meters, analytical balances, microscale kits, etc., to the classroom, (2) two-week summer workshops for teachers on the use of these instruments, (3) day-long seminars for CPACT teachers, (4) opportunities for summer research, (5) science fairs for the students, will be described.

Sunday Evening, August 5

Opening Plenary Session
Toby Block, Presiding

Omni, Convention Center
Ballroom Level

7:00 Welcome and Introductory Remarks, Robert Pierotti

7:00 001 Future Chemistry: Expanding Frontiers vs. Constrained Resources.
Mark Wrighton

8:40 Reception

Monday Morning, August 6

Plenary Session
Stanley Kirschner, Presiding — Omni Convention Center, Ballroom Level

8:00 002 Brasted Lecture: Chemical Education for the International Transfer of Knowledge and Technology. Aleksandra Kornhouser

Theory and Practice of Modern Infrared Spectroscopy
Len Fine, Presiding — Howie (Physics), L2

9:30 Introductory Remarks

9:45 003 How to Observe a Chemical Bond. Bryce Crawford, Jr.

10:15 004 Fourier Transform and Laser Techniques: The Renaissance of Vibrational Spectroscopy. Ian M. Mills

11:00 005 Raman and Infrared (IR) Spectroscopy - Complementary Tools in Science and Technology. Bernhard Schrader

11:45 006 Fourier Transform Raman Spectroscopy. Robert Hannah, Bruce Chase

Human Impact on the Environment - Future Threat or Opportunity?
Victor Mayer, Presiding — AECAL (Chemistry), 17

9:30 007 Global Warming - The Greenhouse Effect. Chad A. Tolman

10:15 008 Hazardous Wastes - Will We Ever See the End of Them? Glen Paulson

11:00 009 CFCs and Ozone: Industry Leadership in Environmental Protection. J. M. Steed

11:45 Panel Discussion

Education for the New Technology (All morning session concluding with panel discussion.)
Alice J. Cunningham, Presiding — Student Center Theater

9:30 010 Education for New Technology. Alice J. Cunningham, Allen J. Bard, C. Anthony Hunt, Bassam Shakhashiri, Mark Wrighton

Forensic Science
Keith Berry, Presiding — A. French, 101

9:30 Introductory Remarks

9:35 011 It's Analytical My Dear Watson!" Rosette M. Roat

10:00 012 **Demonstrations of Forensic Science Techniques: A Videotaped Series for the Enhancement of High School and College/University Science Courses.** Everett J. Nienhouse

10:50 Break

11:00 013 Forensic Chemistry Experiments Your Kids Can Do. Keith O. Berry

11:25 014 Teaching DNA Fingerprinting Techniques in a Forensic Science Course for Criminal Justice Majors. H. E. Outlaw

11:45 015 Forensic Microscopy. Larry Peterson

Paper Chemistry
John Waterhouse, Presiding ESM, 201

9:30 016 The Academic Program of the Institute of Paper Science and Technology. T. J. McDonough

10:05 017 Applications of Biotechnology to Forestry. D. T. Webb, R. J. Dinus

10:40 018 Pulping and Bleaching Chemistry. D. R. Dimmel

11:15 019 Wet End Chemistry. Robert A. Stratton

11:50 020 Papermaking and Paper Products. John F. Waterhouse

Symposium on Chemical Demonstrations (Prerequisite for Workshop No. 18.)
Irwin Talesnick, Presiding Boggs (Chemistry), B6A

9:30 021 Demonstrations, Novel and Easy. Irwin Talesnick

10:30 022 Dazzling Demos and Chemical Bloopers: A Videotape Collection. John J. Fortman

11:30 023 Concrete: Delicate Chemical Reactions Produce Macroscopic Products. Gladysmae C. Good

12:00 024 More "Funky" Science 'Spearments. Patrick E. Funk

Computer Interfacing
James O. Currie, Presiding Boggs (Chemistry), B6

9:30 025 A Beginner's Guide to Interfacing: Tips, Tricks, and Pitfalls. James C. Swartz

10:00 026 Integrating Computers into Science Instruction: Involving Students in the Process of Science. John R. Amend, Ronald P. Furstenau

10:30 027 Computer Interfacing: Making Older Instruments Work Like Newer Models. George C. Lisensky

11:00 028 Measuring Pressures Through the Apple Game Port. James P. Birk, David Walters

11:30 029 Interfaced Fast Luminescence Decay Time Experiment and a General Purpose Nonlinear Least Squares Data Fitting Program. J. N. Demas, S. W. Snyder, R. Ballew

Undergraduate Faculty Enhancement Programs
Curt Sears, Presiding — Howey (Physics), L3

9:30 030 NSF's Plans for Undergraduate Education. Robert F. Watson

10:00 031 Undergraduate Faculty Enhancement Program at NSF. Nina Matheny Roscher

10:30 032 Faculty Enhancement in the Chemical Sciences at the Regional Universities of Mississippi. David L. Wertz

11:00 033 Faculty Professional Enhancement Program at Florida State University. Penny J. Gilmer, Robley J. Light

11:330 034 A Report on the Auburn Undergraduate Inorganic Chemistry Faculty Enhancement Workshop. David M. Stanbury

12:00 035 Workshop Opportunities in Chemistry for Undergraduate Faculty in Southeastern United States. Curtis T. Sears, Jr.

Chemistry in Context: The New ACS College Chemistry Text for Non-Science Majors
A. Truman Schwartz, Presiding — Weber (SST), L1

9:30 036 Chemistry in Context: The ChemCom Concept Goes to College. A. Truman Schwartz

10:00 037 Acid Deposition as an Example of Chemistry in Context. William F. Coleman

10:20 038 Chemistry in Context: The Water Unit. Conrad Stanitski

10:40 039 Energy in ChemText. Arden P. Zipp

11:00 040 ChemText: Activities to Involve Non-Science Majors in Chemistry. Diane M. Bunce

11:30 041 Laboratory Exercises for the Chemically Perplexed. Robert G. Silberman, Wilmer J. Stratton

12:00 General Discussion

Science Courses for Non-Science Students
Mary Fields, Presiding — Weber (SST), L2

9:30 042 College Chemistry for Business Students Using the Issues Approach. David L. Adams

10:05 043 Science of Food: A New Chemistry Course at University of Nebraska. James D. Carr, John H. Rupnow, Nancy M. Betts

10:30 044 Teaching Non-Science Majors to Be More than Science Couch Potatoes. Sylvia J. Berens

11:05 045 Development of Laboratories in Chemistry for the Non-Science Major. Zvi Szafran, Mono M. Singh, Angelicki A. Rigos, Carolyn A. Werman, Stephen A. Leone, J. David Davis, Ronald M. Pike

11:330 046 Biochemistry Options at a Community College. Mary C. Fields

Problem Solving and Assessment
Claire Baker, Presiding ESM, 202

9:30 047 Application of Myers-Briggs Type Indicator to Chemical Education: A Study of the Role of Personality Type in Solving Chemistry Problems. Richard J. Wyma, J. Dudley Herron, Norbert Muller

10:00 048 Effect of Information Format on Students' Problem Solving Strategies. A. W. Friedel, D. P. Maloney

10:35 049 What Are Good Predictors of Freshman Chemistry Scores? Nancy J. S. Peters, Kristen A. Hallock

11:00 050 Prediction of Ultimate Student Performance in General Chemistry From First Exam Scores. Marcy L. Hamby, William R. Robinson

11:25 051 Abstract Adventures in Computer Testing. John Kenkel

11:55 052 Construction and Analysis of Multiple Choice Tests. Claire A. Baker, Robert A. Pribush

Monday Afternoon August 6

Theory and Practice of Modern Infrared Spectroscopy
Robert Hannah, Presiding — Howey (Physics), L2

2:00 Introductory Remarks

2:15 053 Near Infrared Spectroscopy and the New Analytical Paradigm. James B. Callis

2:45 054 Infrared Spectrometry of Non-Traditional Samples. James A. de Haseth

3:15 055 The Utilization of Far Infrared Spectroscopy for the Determination of Conformational Stabilities and Barriers to Internal Rotation. J. R. Durig

3:45 056 Spectroscopy with FT-IR Microscopes. D. W. Schiering

4:15 057 Spectroscopic Studies of Aqueous Al(III) Acetate Solution. K. R. Williams, W. S. Brey, J. L. Bradley, A. G. Fosmoe II, R. Jimenez, J. West, R. Lanier

4:30 058 Reflectance FT-IR Microspectroscopy: The Kramers-Kronig Transform and Its Application. D. W. Schiering

4:45 059 Microscope Optimization for FT-IR Microspectroscopy. D. W. Schiering, E. F. Young

Human Impact on the Environment - Future Threat or Opportunity?
Chad A. Tolman, Presiding — AECAL (Chemistry), 17

2:00 060 Environmental Issues in the Chemistry Curriculum. Victor J. Mayer

2:45 061 How Conflicting Analyses of Global Change Shape Public Perceptions and Teaching Strategies. Will Hon

3:30 062 Environmental Issues on a Global Scale: A Teacher's Perspective. Dan Jax

4:15 Panel Discussion

Improving the Public Image of Chemistry (Panel discussion with Plenary speakers.)
Beth Pulliam, Presiding — AECAL (Chemistry), 16

2:00 063 Improving the Public Image of Chemistry. E. J. Pulliam, Moderator, Mark Wrighton, Walter McCrone, Bassam Shakhashiri, Marjorie Gardner

New Directions in Anti-Aids Drugs
Curt Sears, Presiding — Mason (CE), 142

2:00 064 Discovery and Development of Therapies to Treat Aids and Its Sequela.

Margaret I. Johnston, Nava Sarver, Mohamed Nasr, Charles Litterst

2:45 065 Anti-HIV Activity of 3'-Azido-3'-Deoxythymidine and Related Compounds. J. L. Rideout

3:30 066 HIV Protease as a Therapeutic Target. Garland R. Marshall

4:15 067 The Design of New Therapeutic Agents Against the Human Immunodeficiency Virus. Dabney W. Dixon

Woodrow Wilson Environmental Team (1/2 session)
Penney Sconzo, Presiding — Boggs (Chemistry), B6A

2:00 068 Environmental Chemistry-Dreyfus/Woodrow Wilson Foundation. Linda M. Stroud, DeWayne L. Lieneman, Richard Willis, Denise L. Creech

Plastics in the Environment: An Industrial Perspective (1/2 session)
Penney Sconzo, Presiding — Boggs (Chemistry), B6A

3:30 069 Plastics in the Environment: An Industrial Perspective. Jim Brown

Hypercard and Hypertext Applications
Dave Brooks, Presiding — Boggs (Chemistry), B6

2:00 070 HyperCard Chemistry Stacks. D. W. Brooks

2:35 071 Using HyperCard to Control Animated Graphics. John I. Gelder

3:35 072 HyperMedia in Undergraduate Organic Laboratory Instruction. Paul F. Schatz

4:30 073 Event-Driven, Object-Oriented Programming in HyperTalk. D. W. Brooks

Innovations in Teaching Physical Chemistry
Ann B. Manner, Presiding — Mason (CE), 142A

2:00 074 Blackboard Chemistry Using the VIF. Oktay Sinanoglu

3:00 075 An Intermediate Course in Molecular Spectroscopy and Quantum Chemistry. C. Weldon Mathews

4:00 076 Application Problems in Physical Chemistry. David M. Whisnant

Low-Cost Equipment and Materials
Ram Lamba, Presiding — Howey (Physics), L1

2:00 077 Comparative Performance of Locally Produced vs. Commercial Equipment. Ramón A. De La Cuétara, Ram S. Lamba

2:35 078 Low Cost Devices for Overhead Projector Demonstrations. Sally Solomon

3:10 079 High Educational Yields from Using Low Cost Equipment. Alice J. Cunningham

3:45 080 Simple Demonstrations and Experiments Utilizing Household Materials. Toby F. Block

4:10 081 Teaching Environmental Chemistry Through Experiments. Krishna V. Sane

Recruiting and Retaining Chemistry Majors
Bill Robinson, Presiding — Weber (SST), L1

2:00 082 Students' Science Autobiographies: Telling Tales of Science Turnoffs. Patricia A. Metz, Nancy W. Brickhouse

2:25 083 The Promise of Middle Science. Patricia L. Samuel

2:50 084 Re-entry and Reverse Transfer Students: Shifting the Equilibrium. T. Y. Susskind

3:35 085 Chemistry Majors from First Year Students. Stephen J. Hawkes

3:55 086 Where Have All the Majors Gone? J. J. Lagowski

4:15 087 Building Bonds: Developing a Community of Chemists. William S. Harwood

ChemCom: Chemistry in the Community
Martha K. Turckes, Presiding — Howey (Physics), L3

2:00 088 Chemistry in the Community: What's It All About? Martha K. Turckes

3:05 089 Taking ChemCom to the Field. Marge Christoph, Clair Clawson, John Wilcox, Nancy W. Brickhouse

3:35 090 ChemCom as a College Course for Non-Science Majors. Curtis C.Wilkins

Poster Session: Technology, Computers, Videos and More!
2:00 - 5:00 — Student Center, 343

091 Soaps and Detergents in Hard Water, a Laboratory for Non-Science Majors. Pamela M. Fier-Hansen

092 Use of a Spreadsheet for the Statistical Analysis of Data in the Physical Chemistry Laboratory. John C. Hansen, Pamela M. Fier-Hansen

093 Molecular Quantum Mechanics and Computer Graphics in the Physical Chemistry Laboratory. George C. Shields

094 Determination of the Effectiveness of a Program Designed to Encourage Elementary Teachers to Teach Science in a Hands-On Mode. Robert L. Hartshorn, Phillip H. Davis

095 A Hypercard Simulation of Liquid Scintillation Counting for the Undergraduate Biochemistry Laboratory. Nancy L. Devino, George C. Lisensky

096 Silver Ion Equilibria Demonstration with Nernst Equation and Nine Equilibrium Constants. Robert Hunt Anderson

097 Use of Lotus 123 in Physical Chemistry Laboratory. P. Nambi, Joseph Bean, Will Mann

098 Interactive Videodisc Computer Aided Instruction for the Microscale Organic Chemistry Laboratory. Charles E. Sundin

099 An Interactive Hypercard Organic Mechanism Tutorial. R. W. Kleinman

100 Microboiling Points Using the Mel-Temp® Melting Point Apparatus. Biorn Olesen

101 Chemical Inventory Control. Wyman K. Grindstaff, Christine J. Edwards

102 Award-Winning Chemistry Software. Robert B. Kozma, Jerome Johnston

477 Introduction of Computer Technology into the Chemistry Classroom/Laboratory. Carol O. Zimmerman, Harry A. Smith

479 Microcomputer Instruction in Proton NMR Spectra Interpretation. Kersey A. Black

Tuesday Morning, August 7

Plenary Session
Edward Mellon, Presiding — Omni, Convention Center Ballroom Level

8:00 103 Microscopy: Why Not Ultramicro....Walter McCrone

FIPSE FOLLOW-UP SYMPOSIUM: Teaching with Today's Technology - Descriptive Chemistry (Ticket required; limited enrollment; see Workshop No. 27 for description.)
Jack Kotz, Presiding — Weber (SST), Upper

9:30 104 Introduction to the FIPSE Follow-Up Symposium. John W. Moore

9:40 105 Advanced Technology Lecture Hall. Installation and Startup. Kenneth E. Bower, Cynthia W. Porter, Robert Ferrante, Charles Bower, Roger W. Strassburg

10:30 Concurrent Sessions

106 Interactive Videodisc Computers and the Exploring Chemistry Lessons. John J. Fortman

107 KC?Discoverer as a Classroom Catalyst. Karen E. Eichstadt, Peter J. Tandler, Douglas C. Rader

108 Lecture Experiments Using Interactive Videodisc. John I. Gelder

109 Extending the Laboratory Via Interactive Video. Gery Essenmacher, Sean Gammon, Teresa Anderson

11:50 Wrap Up Session

Topics in Nuclear and Radiochemistry for College Curricula and High School Science Programs
Trish Baisden, Joanna Fowler, Presiding — Howey (Physics), L3

9:30 Introductory Remarks

9:40 110 Radiation and Society. Rosalyn S. Yalow

10:30 111 Introduction to Nuclear Medicine Imaging and Research. Dennis P. Swanson

11:00 Break

11:10 112 Radiochemistry and Positron Emission Tomography (PET). Michael J. Welch

11:40 113 The Use of Radioisotopes to Determine Growth Rates of Marine Organisms: A Case Study of the Chambered Nautilus. J. K. Cochran, N. H.

Landman

12:10 114 On the Use of Radioactive Drugs to Understand Brain Chemistry. R. J. Hitzemann

Chemical Microscopy
Walter McCrone, Presiding — Howey (Physics), L2

9:30 Introductory Remarks

9:32 115 Polarized Light Microscopy - Techniques I. Gary J. Laughlin

10:00 116 Polarized Light Microscopy - Techniques II. Stephen Skirius

10:30 117 Applications of the Polarized Light Microscope in the Forensic Laboratory - Hair, Fibers and the Atlanta Murders. Larry Peterson

11:00 Break

11:30 118 Applications of Chemical Microscopy in the Crime Laboratory - Soils, Minerals and Murders. John Kilbourn

12:00 119 Applications of Chemical Microscopy in the Forensic Laboratory - Drugs. Joe Koles

New Directions in Teaching Inorganic Chemistry
J. G. Verkade, Presiding — Weber (SST), L2

9:30 Introductory Remarks

9:35 120 The Place of Inorganic Chemistry in the New Degree Options of the Committee on Professional Training (ACS). Herbert D. Kaesz

10:05 121 What Topics Should Be Covered in the Intermediate Inorganic Course? John G. Verkade

10:40 122 Catalyzing Solid-State Chemistry Instruction. Arthur B. Ellis

11:10 Break

11:30 123 Inorganic Chemistry for Biochemists: An Idea Whose Time Has Come? B. A. Averill. WITHDRAWN

12:00 124 Including Inorganic Diversity in the ACS Inorganic Exam(s). John M. DeKorte

General Chemistry Laboratory Coordinators
Barbara Sawrey, Presiding — Weber (SST), L1

9:30 Introductory Remarks

9:40 125 The Multi-Faceted Role of a Freshman Laboratory Coordinator. Fred

E. Wood

10:10 126 A Cog on a Wheel in the General Chemistry Machine. Patricia A. Metz

10:40 127 In Search of the Lost Chord: Coordinating the General Chemistry Program at SMU. Thomas J. Greenbowe

11:10 128 General Chemistry Coordinators: Who the Heck are We? B. A. Sawrey

11:40 129 Improving a Freshman Lab Program: Goals and Realities. S. T. Marcus

12:10 130 The Laboratory Coordinator at Vassar College. Christina Noring Hammond

Perspectives in AP Chemistry
Hessy Taft, Presiding — A. French, 101

9:30 Introductory Remarks

9:40 131 Why Advanced Placement Chemistry? Ronald D. Archer

10:05 132 Highlights of an AP Chemistry Course. A. Joe Clark

10:30 133 AP Chemistry Laboratory. Frank Cardulla

10:55 134 The AP Chemistry Exam - How is it Evaluated? Arden P. Zipp

11:20 135 Present Concerns. Gregory R. Choppin

11:45 136 AP Chemistry Students at the University of Michigan. M. David Curtis, Seyhan N. Ege

12:10 Open Discussion. Dave Brooks, discussant.

Applications of State-of-the-Art-Hardware
Al Lata, Presiding — Boggs (Chemistry), B6

9:30 137 New Tools for Interactive Video. Stanley Smith

10:00 138 CD-ROM as a Storage Medium. Alton J. Banks

10:30 139 Enhancing Instruction with Digitized Video Imagery. Loretta L. Jones

11:00 140 Application of Commercial Hardware-Software Packages to Data Acquisition and Control in the Teaching Laboratory. Thomas H. Ridgway

11:30 141 Chemistry and the NeXT Computer. Alfred J. Lata

12:00 142 Do They Hear What I Hear: The Kazoo of Chemistry. Alfred J. Lata

Salter's Chemistry and Salter's Science (1/2 session)
Mary Beth Key, Presiding — Boggs (Chemistry), B6A

9:30 480 Context: Science Teaching in England. David Waddington, Alan Marsden, Christie Borgford, Mary Beth Key

World of Chemistry (College) (See related afternoon Workshop No. 19.)
Nava Ben-Zvi, Presiding — Boggs (Chemistry), B6A

11:30 143 The World of Chemistry: The Impact On Student's Cognitive and Affective Domains. Nava Ben-Zvi

Alternate Approaches to the Chemistry Lecture
Derek A. Davenport, Presiding — AECAL (Chemistry), 17

9:30 144 What is Wrong with the General Chemistry Course? R. J. Gillespie

9:55 145 Philosophy of Chemistry in the U.K. Science Curriculum. F. Michael Akeroyd

10:25 146 Design of a Course in Critical Thinking. John E. Bauman

10:45 147 Are We Training Students to Make Observations? John Tanaka, Marie Sedotti

11:05 148 The Use of "Marathon" Problems as Effective Vehicles for the Presentation of Freshman Chemistry Lectures. James H. Burness

11:30 149 Writing in General Chemistry. Melanie M. Cooper

11:50 150 The Use of "Writing To Learn" in a Large Organic Lecture Course. Kenneth O. Pohlmann

Microscale General Chemistry Labs
Mike Hampton, Jerry Mills, Presiding — AECAL (Chemistry), 16

9:30 151 Microscale General Chemistry Experiments. Michael D. Hampton, Jerry L. Mills

10:00 152 Microchemistry Lab Techniques for High School Chemistry. John J. Mauch

10:30 153 Innovative Microscale Lab Techniques and Demonstrations. Bob Becker

11:00 154 Microscale General Chemistry Experiments for Macroscale Classrooms: A Simple "Activity Series" Experiment. Marcia Bailey

11:30 155 Microscale Laboratory Investigation. Jerry A. Bell, Linda R. Wolf

12:00 156 Reemphasizing the Inorganic Component of General Chemistry Through the Use of Microscale Laboratory Techniques. Zvi Szafran, Ronald M. Pike, Mono M. Singh

12:30 157 Microscale Determination of Magnetic Susceptibility. John Woolcock, Zvi Szafran, Ronald Pike, Mono M. Singh

Poster Session: Microscale Organic Labs
9:30 - 12:30 Student Center, 320 + 321

158 Microscale Synthesis, Reactions and Analysis of Lead(II) Iodide from Lead(II) Carbonate. An Advanced General or Sophomore Inorganic Chemistry Laboratory. Mono M. Singh, Zvi Szafran, Ronald M. Pike

159 Preparation of Butenes by E_1 and E_2 Elimination. Bjorn Olesen

160 Microscale Reactions of Vanillin. Rosemary Fowler

161 A Combination of Microscale and Macroscale Organic Laboratory. Richard J. Watkins

162 Recovery of Silver from Silver Waste. A. H. Ackerman, J. A. Murphy, J. K. Heeren

163 New Microscale Experiments. Gottfried Brieger

164 A Microscale Sublimator and Other Microscale Developments. Anthony Winston

165 Use of Microscale Mixtures as Qualitative Organic Unknowns. James A. Beres

166 A New Approach to Microscale Organic Chemistry. R. W. Holman, R. K. Hessley, R. Beauvais, S. Bosch, L. Hayes, M. Lyons, K. Smith

167 A Convenient, High Yield Method of Esterification. P. Di Raddo

168 NMR in a Microscale Environment. Clifford M. Utermoehlen, Paul E. Vorndam

169 Microscale Laboratory on a Shoestring Budget. John A. Landgrebe

170 A Versatile New Microscale Glassware Component. Ronald Starkey

171 Microscale Vacuum Distillation. Donald L. Pavia, Gary M. Lampman, George S. Kriz, Randall G. Engel

172 Microscale Organic Laboratory Experiments. Gerald W. Rausch

173 Aromatic Polyols from Reclaimed Polyethylene Terephthalate: A Polymer Recycling Experiment. Dale Teeters, Paige Johnson

174 A Microscale Benzene-Toluene Competition Experiment. R. A. Berry, C. E. Cain

Tuesday Afternoon, August 7

FIPSE FOLLOW-UP SYMPOSIUM: Teaching with Today's Technology - Descriptive Chemistry (Ticket required; limited enrollment; see workshop No. 27 for description.) Weber (SST), Upper
Jack Kotz, Presiding

2:00 104 Introduction to the FIPSE Follow-Up Symposium. John W. Moore

2:10 105 Advanced Technology Lecture Hall. Installation and Startup. Kenneth E. Bower, Cynthia W. Porter, Robert Ferrante, Charles Bower, Roger W. Strassburg

3:00 Concurrent Sessions

106 Interactive Videodisc Computers and the Exploring Chemistry Lessons. John J. Fortman

107 KC?Discoverer as a Classroom Catalyst. Karen E. Eichstadt, Peter J. Tandler, Douglas C. Rader

108 Lecture Experiments Using Interactive Videodisc. John I. Gelder

109 Extending the Laboratory Via Interactive Video. Gery Essenmacher, Steven Gammon, Teresa Anderson

4:20 Wrap Up Session

The Chemistry of Nuclear Power
Greg Choppin, Presiding Howey (Physics), L3

2:00 Introductory Remarks

2:10 175 Principles of Nuclear Fission. G. Friedlander

2:40 176 The Chemistry of Plutonium. Gregory R. Choppin

3:10 177 Present and Future Nuclear Reactors. W. F. Miller, Jr.

3:40 Break

4:00 178 Natural Nuclear Reactors--The Oklo Phenomenon. George A. Cowan

4:30 179 Options for Nuclear Waste Disposal. Patricia A. Baisden

Chemical Microscopy
Walter McCrone, Presiding Howey (Physics), L2

2:00 180 Applications of the Polarized Light Microscope in the Pharmaceutical Industry. Scott Aldrich

2:30 181 Application of the Polarized Light Microscope to Asbestos Identification. John Henderson

3:00 182 Application of Polarized Light Microscopy to Product Identification. Thom Hopen

3:30 Break

4:00 183 Application of Polarized Light Microscopy to Archaeology. Donna Mefford

4:30 184 Application of Polarized Light Microscopy to Art Authentication. Walter C. McCrone

New Directions in Teaching Inorganic Chemistry
Gary Wulfsberg, Presiding — Weber (SST), L2

2:00 185 Using Artificial Intelligence to Predict Inorganic Reactivity. James P. Birk

2:20 186 Molecular Orbitals Made Friendly - A Non-Mathematical, Non-Group Theoretical Pictorial Approach. John G. Verkade

2:40 187 Using Biographies in Inorganic Chemistry. D.C. Finster

3:00 188 An Interconnected Network of Ideas for Understanding the Periodic Table. Glen E. Rodgers

3:20 Break

3:40 189 Microscale Inorganic Laboratory at the Sophomore Level. Zvi Szafran, Ronald M. Pike, Mono M. Singh

4:00 190 The Role of the Laboratory Component in Advanced Inorganic Chemistry. Gregory J. Grant

4:20 191 Advanced Inorganic Chemistry at California State University, Sacramento. Londa Borer

4:40 192 Discussion-Demonstration Laboratory Experiments in a Lecture-Only Descriptive Inorganic Class. Gary P. Wulfsberg

Computer Graphics
Larry M. Julien, Presiding — Boggs (Chemistry), B6A

2:00 193 Graphic Computer Animations on the Apple IIGS for Lectures. Larry M. Julien

220 194 Graphics in a Full Course Computer Curriculum in General Chemistry. James D. Spain

3:00 195 Animated Simulations and Demonstrations for Chemistry Lecture

Classes. Philip I. Pavlik

3:40 196 Computer Graphics Display of Molecular Orbitals. R. H. Batt

4:20 197 Interactive Computer Graphics: Visualization Methods for Modelling Complex Molecular Systems. W. Jeffrey Howe

Enviromental Panel Discussion
C. S. Kiang, Presiding — AECAL (Chemistry), 17

2:00 198 Environmental Panel. C. S. Kiang, D. M. Cunnold, F. M. Saunders, J. Nemeth

General Chemistry Textbook Authors and Editors Meet Their Public (2½ hour symposium: subsidized reception follows in poster area.)
Conrad Stanitski, Presiding — Student Center Theater

2:00 199 Symposium: General Chemistry Textbook Authors and Editors Meet Their Public. Conrad Stanitski

The Microscale Organic Chemistry Laboratory
Charles Sundin, Presiding — AECAL (Chemistry), 16

2:00 200 The Microscale Organic Chemistry Laboratory, An Introduction. Charles E. Sundin

2:01 201 Continuing Developments in Microscale Organic Laboratory. Donald L. Pavia, Gary M. Lampman, George S. Kriz, Randall G. Engel

2:35 202 Conversion of a Laboratory Program to Microscale. John H. Penn

3:00 203 Introducing Microscale Experimentation at a Large University. New Experiments and Apparatus. Kenneth L. Williamson

3:25 204 New Directions in Laboratory Design for Micro-Scale Laboratories. Grave J. Shaw, George H. Wahl, Jr.

3:50 205 A Microscale Laboratory for Freshmen Based on the Solving of Individual Problems. Seyhan N. Ege

4:15 206 Standard and Microscale Organic Chemistry Experiments. Oscar R. Rodig, Charles E. Bell, Jr., Allen K. Clark

4:40 207 A Comparison Between Microscale Techniques. Maria A. Aponte

Cultural Diversity in Chemistry
Catherine Middlecamp, Presiding — Mason (CE), 142

2:00 108 Cultural Diversity in the Chemistry Curriculum. Catherine Middlecamp

2:35 209 Teaching Chemistry to Asian-American Students. Agnes Lee, Catherine Middlecamp

3:10 210 Finding Some Powerful Ways to Reach Minority and Female Students. Elizabeth Kean

3:35 211 Young Women and Chemistry as a Career Choice. Why Not? Rita K.Hessley

3:55 212 Some Suggestions for Teaching Chemistry to Visually Impaired Students. Harry E. Pence, Lorie Beers, Michael Washburn

4:20 213 Increasing Learning in the Laboratory for All Students...Especially Those "At Risk". Ronald J. Schwarz

4:45 214 Advising Chemistry Students About Medical School. D. M. Sullivan

General Contributed Papers
Jay Bardole, Presiding — Boggs (Chemistry), B6

2:00 215 What Happens to Student Performance When Their Control Over CAI Programs is Maximized? Michael P. Doherty, George M. Bodner

2:20 216 What Happens to Performance When Students Do Not Spend Enough Time Per Problem in CAI Programs? Michael P. Doherty, George M. Bodner

2:40 217 The Land of OZone. Patrick K. Monaghan

3:00 218 General Chemistry "Help" Sessions. Tim Goodman

3:15 219 The Role of Potential Energy in Chemistry. R. Thomas Myers

3:40 220 A Primer on Hazardous Materials, Chemicals, and Waste. S. M. Wright

4:00 221 A Pictorial Tour Through the Liebig Laboratory/Museum. Norman W. Hunter

4:15 222 The Ozone Hole: Motivation for Chemical Education. Herb Bassow

4:45 223 Beyond the Fringe: DA, STS and SETI. Clifford N. Matthews

Poster Session: Microscale General Chemistry
2:00 - 5:00 — Student Center, 320 +321

224 The Instructional Versatilities of Microscale Laboratory. Ning Huai Zhou

225 A Small-Scale Approach to General Chemistry Laboratory Instruction. Rosemary Fowler

226 Simple Cells for Potentiometry. Howard P. Williams

227 Critical Thinking and the Introductory Laboratory. Brian P. Coppola

228 Facilitation of High School Microscale Laboratories Via a Laboratory

Equipment Assistance Program (LEAP). Frank J. Dinan, Joseph F. Bieron

229 Significant Figures in Multiplication and Division. Clyde R. Metz

230 Teaching Inorganic Nomenclature: A Systematic Approach. Gerhard Lind

231 Teaching How to Balance Redox Equations - A 10-Step Recipe. Gerhard Lind

232 A Low Cost, Safe, and Portable Apparatus for Lecture Hall Conductivity Demonstration. Gary D. Mercer

Five-Minute Poster Session
Kathy Dombrick, Presiding Student Center, 320 + 321

2:00 233 Enhancement of General Chemistry Laboratory Curriculum Through Use of Inexpensive Digital pH-mV-Temp Meter. Charles J. Bier

2:10 234 Ammonia Mini-Fountain. Dianne N. Epp

2:20 235 Writing Across the Chemistry Curriculum: Organic Chemistry. Francis M. Klein

2:30 236 Integrated Experiment for General Chemistry: Preparation and Analysis of a Cobalt Coordination Compound. Anne T. Sherren

2:40 237 IDIRICE: Moving Beyond the Aqueous Equilibria ICE Table. Edward A. Mottel

2:50 238 Simple and Inexpensive Kinetics: A Student Laboratory Experiment. David K. Erwin

3:00 239 The Role of Video Equipment and Microscopy in Chemical Education. Tomas G. Berger, Stephen A. Skirius

Wednesday Morning, August 8

Plenary Session
Truman Schwartz, Presiding — Omni, Convention Center Ballroom Level

8:00 240 Science Education in the 1990's: Issues and Opportunities. Bassam Shakhashiri

FIPSE Follow-up Symposium: Teaching with Today's Technology - Upper Division Chemistry (Ticket required; limited enrollment; see workshop No. 28 for description.)
Paul Schatz, Presiding — Weber (SST), Upper

9:30 104 Introduction to the FIPSE Follow-Up Symposium. John W. Moore

9:40 241 Microcomputer as Electronic Blackboard: A Course in Organic Chemistry. Joseph Casanova

10:20 Concurrent Sessions

242 Plane Group Symmetries: A Program for Mac Computers. M. E. Kastner

243 Spreadsheets in Upper-Level Chemistry Courses. David M. Whisnant

244 Using KC?Discoverer in a Sophomore Inorganic Course. John C. Kotz

245 Applications of Mathematical Software in Teaching Quantum Chemistry. William F.Coleman

246 The Use of Computers in the Organic Chemistry Curriculum. Sandra I. Lamb

12:00 Wrap Up Session

Radioactivity in Science and Industry
Glenn E. Gordon, Presiding — Howey (Physics), L3

9:30 Introductory Remards

9:40 247 Neutron Activation Analysis: Solving the Mystery of Airborne Rare Earths. G. E. Gordon

10:10 248 Neutron Activation Analysis and Volcanoes. W. H. Zoller

10:40 Break

11:00 249 Neutron Activation Analysis in Scientific Crime Investigation. Vincent P. Guinn

11:30 250 The Role of Radiocarbon in Air Pollution Research. Ann E. Sheffield

12:00 251 Archaeology and Nuclear Chemistry. M. James Blackman

Reactivity Network
Zaida Morales-Martinez, Presiding — Student Center Theater

9:30 252 The Chemistry of Chromium. John C. Kotz, Alexander Ide, Anne Whitesides

10:05 253 Chemical Reactivity of Nickel. James P. Birk, Martha Ronan, Imogene Bennett, Cheri Kinney

10:40 254 Reactions of Sulfur and Some of Its Compounds. R. J. Gillespie, D. A. Humphreys

11:15 255 Chlorine and Bromine. W. D. Perry, Michael Edmondson, John Halbrooks

11:50 256 Chemical Reactivity of Aluminum. Zaida C. Morales-Martinez, Elizabeth Bednar Moore, Evelyn DuCharme

Five-Minute Demonstrations
Mary Bailey, Presiding — Howey (Physics), L2

9:30 257 An Alkene Addition Reaction. Mary H. Bailey

9:40 258 The Hydrogen Iodide and Chlorine Replacement Reaction. Ralph A. Burns

9:50 259 Production and Combustion of Acetylene. Mary H. Bailey

10:00 260 A Tortuous Route for Black Powder Fuse. John J. Fortman

10:10 261 More Demonstrations with Red Cabbage Indicator. John J. Fortman, Katherine M. Stubbs

10:20 262 Two-Color Formaldehyde Double Clock Salutes. John J. Fortman, Jeffrey A. Schreier

10:30 263 A Miniature Hot Air Balloon for Illustrating Charles' Law. William C. Deese

10:40 264 Identifying Plastics by Density. Doris K. Kolb, Kenneth E. Kolb

10:50 265 Comparing Water Content of Margarines. A. Donald Glover, Kenneth E. Kolb

11:00 266 Diffraction Grating Spectra. Edward A. Mottel

11:10 267 Five-Minute Demonstrations - A Colorful Display of the Scientific Method. George L. Gilbert

11:20 268 Aldol Condensations: Color Formation and Rate. Ernest F. Silversmith

11:30 269 A Simple Electrochemical Concentration Cell. John V. Rund

11:40 270 Weak Electrolytes: Metal Ion Complexes. Jerry A. Bell

11:50 271 A Simple Demonstration of Air Pressure. Jerrold Greenberg

12:00 272 A Quick Catalyst Demonstration. Patrick E. Funk

12:10 478 Using a Motor to Demonstrate Conductivity on the Overhead. Sally Solomon

Polymers and Advanced Chemical Education
Tom Vickers, Presiding Boggs (Chemistry), B6A

9:30 273 Polymer Topics in Undergraduate Analytical Chemistry. T. J. Vickers, R. Alamo, C. K. Mann, L. Mandelkern

9:50 274 Polymer Application in Construction Engineering. D. Feldman

10:05 275 Theoretical Applied Chemistry. F. Michael Akeroyd

10:30 275 Intramolecular Charge Effects - Back to Electrostatics. George I. H. Hanania, Steven O. Russo

10:50 277 Organic Tutorial. Bruce N. Campbell, Jr.

11:00 278 X-Ray Crystallography: A Four-Week, No Lecture, Hands-On Course for Undergraduates. M. E. Kastner

11:30 279 Clusters, A Different Phase Of Matter: A Graduate Course. Muriel B. Bishop, M. A. Duncan

11:50 280 How to Make Teaching about Polymers Interesting and Fun. Robert Alan Shaner. WITHDRAWN

Organic Chemistry in the One-Person Department
Leo Kling, Presiding ESM, 201

9:30 281 Organic Chemistry at a Rural Community College. Leo Kling III

10:00 282 The Lone Chemist: Challenges of the One-Person Chemistry Program at a Four Year College. Mary Frances Dove

10:30 283 The Text, Text Author, and Publisher as Resources. F. A. Carey

11:00 284 Microscale Organic Laboratory in the One-Person Department. Randall G. Engel

11:30 285 Safe Handling and Legal Disposal of Laboratory Chemicals at Academic Institutions. Dennis D. Graham

12:00 286 What Science Suppliers Can Offer Small Departments. Marian H. Snow

Laboratory Assessment Builds Success
Patricia Smith, Presiding ESM, 202

9:30 287 The Three-Year ICE Laboratory Leadership Project: An Overview. Marjorie H. Gardner

9:50 288 The High School Chemistry Lab: Survival vs. Strictures. Darrell H. Beach

10:10 289 Overview of the Laboratory Component: A Matrix Map. Otto Phanstiel

10:20 290 Assessing Student Laboratory Understanding Through "Pictures in the Mind". Helen M. Stone

10:50 291 Cultivating Writing and Communication Skills Through Laboratory-Based Activities and Assessment Tasks. Allene Johnson

11:10 292 Adapting Old-Hat Lab Activities to Cultivate Higher-Order Outcomes: A Workshop Presentation. Pat Phillips, Floyd Sturtevant, Gladysmae C. Good

11:50 293 "Chemical Sense" and Laboratory Safety. Ken Hartman

12:19 294 Anecdotal Episodes, Parallel Laboratory Activities, and Related Approaches to Evaluating Student Understanding. Gladysmae C. Good

World of Chemistry (High School) (See related afternoon workshop No. 24.)
Mary Beth Key, Presiding Weber (SST), L1

11:30 295 High School Version of the World of Chemistry. Mary Beth Key, Ron Crampton, Edward Gibb, Carole Goshorn, Cliff Schrader, Patricia Smith

Teaching High School Chemistry
Ed Koubel, Presiding AECAL (Chemistry), 17

9:30 296 Laboratory Techniques and Research Skills: A One-Semester Course to Teach Skills Basic to Science. M. G. Sibert

9:55 297 High School Chemistry Instrumentation Course. Londa Borer, Hans Deuel

10:20 298 Do We Have to Think Today? Kathryn G. Windham

11:10 299 The Best Laid Plans: Obstacles That Must be Overcome to Bring About Lasting Reform in Science Education. Amy Phelps, George Bodner

11:35 300 The Teaching of Chemistry in Bolivian High Schools. Saul J. Escalera

12:05 301 Fun and Games in Chemistry Class. Deborah G. Courtney

High Technology in the Classroom and Laboratory Boggs (Chemistry), B6

Michael Abraham, Presiding

9:30 302 The MacLecture Project: Teaching Chemistry with a Macintosh Linked to an Overhead Projector. Robert J. Brenstein, Conrad C. Hinckley

10:05 303 Integrating the Laboratory and Lecture with Computers. Michael R. Abraham, Eric L. Enwall

10:30 304 Computer Interfacing in a Chemistry Laboratory: No Pain! Much Gain! Richard Wyma, Eric Higbie, James May

11:00 305 In-House Production of Pre-Lab Video Programs. Howard J. DeVoe

11:25 306 Production and Utilization of Video in Laboratory Instruction. Karen E. Eichstadt, Andrew P. Lokie, Jr.

11:50 307 3-D pH Plots Using Advanced Spreadsheet Scripting. James O. Currie, Jr., Richard V. Whiteley

308 See Abstract 098

Wednesday Afternoon, August 8

FIPSE Follow-up Symposium: Teaching With Today's Technology - Upper Division Chemistry (Ticket required; limited enrollment; see workshop No. 28 for description.)
Paul Schatz, Presiding — Weber (SST), Upper

2:00 104 Introdution to the FIPSE Follow-up Symposium. John W. Moore

2:10 241 Microcomputer as Electronic Blackboard: A Course in Organic Chemistry. Joseph Casanova

2:50 Concurrent Sessions

242 Plane Group Symmetries: A Program for Mac Computers. M. E. Kastner

243 Spreadsheets in Upper-Level Chemistry Courses. David M. Whisnant

244 Using KC?Discoverer in a Sophomore Inorganic Course. John C. Kotz

245 Applications of Mathematical Software in Teaching Quantum Chemistry. William F.Coleman

246 The Use of Computers in the Organic Chemistry Curriculum. Sandra I. Lamb

4:30 Wrap Up Session

Nuclear and Radiochemistry at the Forefront of Science
Vic Viola, Presiding — Howey (Physics), L3

2:00 309 The Role of Chemists in the Development of Nuclear Science. V. E. Viola

2:10 310 The Synthetic Elements. Darleane C. Hoffman

2:50 311 Nuclear Chemistry and Cosmology. Richard L. Hahn

3:30 Break

3:40 312 How Can We Understand Hot Atomic Nuclei? John M. Alexander

4:20 313 Accelerators for Research and Applications. Jose R. Alonso

Geochemistry
Bill Cooper, Presiding — Student Center, 343

2:00 Introductory Remarks

2:15 314 Trace Metal Biogeochemistry in the Ocean. W. M. Landing

2:45 315 Biomarkers - The Interaction Between Organic Chemistry and Geology

in Petroleum Exploration. R. P. Philp

3:15 316 Preservation of Organic Matter in Wetland Peats: Modern Analogues of Ancient Coal-Forming Environments. William H. Orem, Harry E. Lerch

3:45 317 Development of a Geochemistry Lab Manual. R. H. Langley, E. B. Ledger

4:15 318 The Use of Solid State ^{13}C NMR Spectroscopy in Developing Environmental and Geochemical Qsar Parameters. William T. Cooper

ChemSource (Coordinated reception follows.)
Mary Beth Key, Mary Virginia Orna, Presiding Boggs (Chemistry), B6

2:00 Introductory Remarks

2:05 319 ChemSource: An Overview. Mary Virginia Orna, Mary Beth Key

2:15 320 The SourceView Component of ChemSource. Dorothy Gabel

2:35 321 SourceBook: A Strategy for Delivering Day-To-Day Support for Chemistry Teaching. Marjorie Gardner, Henry Heikkinen

2:55 Break

3:15 322 SourceBook Preview #1: Support for a Conceptually-Oriented Chemistry Topic: Equilibrium. Michael Ray Abraham

3:35 323 SourceBook Preview #2: Support for a Descriptive Chemistry Topic: Halogens. Abe Rennert

3:55 324 SourceBook Preview #3: Support for an Applied/Enrichment Chemistry Topic: Biochemistry and Enzymes. Lee Summerlin

4:15 325 ChemSource: Discussion and Feedback Session. Mary Virginia Orna, Mary Beth Key, Dorothy Gabel, Marjorie Gardner, Henry Heikkinen

Graduate Study In Chemical Education (1/2 session)
Penney Sconzo, Presiding Mason (CE), 142A

2:00 326 Graduate Studies in Chemical Education. Mary M. Atwater, Martin V. Stewart, Henry Heikkinen, Dudley Herron

CEPUP: Chemical Education in Schools, the Workplace and the Community
Ron Laugen, Presiding Howey (Physics), L2

2:00 327 CEPUP Program Overview. R. C. Laugen

2:30 328 Why CEPUP? Chemical Education and Issues. H. D. Thier

3:00 329 CEPUP: Chemical Education in Schools. S. Hill

3:30 330 Living with Chemicals: A Community Project. E. Anderson, B. Saiet

4:00 331 Chemical Education: An Industry View. G. Affleck

Neat, Wow, Super Chemistry! DIVCHED and the High School Teacher
Ron Perkins, Presiding — AECAL (Chemistry), 16

2:00 332 Getting Students to Profit from Chemistry. Clifford L. Schrader

2:40 333 The Easy Way to do Chemical Demonstrations. Doris K. Kolb

3:10 Break

3:20 334 Rube Goldberg Chemistry Contest. Ron Perkins, Mark Strauss

3:50 335 Student Investigations: Developing a Demonstration. Jerry A. Bell

4:20 Announce Winner of Rube Goldberg Contest

Models and Tools for Teaching
Herb Bassow, Presiding — Mason (CE), 142

2:00 336 A Tool for Teaching Acid/Base Titration Calculations. Carl B. Bishop

2:25 337 Systematic Calculation of pH for Complex Systems. Garry F. Warnock, Henry A. Bent

2:50 338 Competing Equilibria in Acid - Base Systems. Lawrence L. Garber, George V. Nazaroff

3:15 339 The Principal Equations of Reaction Stoichiometry. Ning Huai Zhou, J. Edmund White

3:35 340 Interactive Model System for Teaching Molecular Chemistry. H. J. Teague

4:00 341 Predicting Crystal Structure with Simple Geometry. Herb Bassow

New Laboratory Experiments
Gail Meyer, Greg Grant, Presiding — Boggs (Chemistry), B6A

2:00 342 Designing a User-Friendly Laboratory for First Semester General Chemistry. Gail M. Meyer, Gregory J. Grant

2:15 343 The Laboratory Component in Second Semester General Chemistry. Gail M. Meyer, Gregory J. Grant

2:30 344 Preparation and Use of Liquid Oxygen. D. M. Sullivan

2:45 345 Determination of Solubility Product Constant for Calcium Fluoride: A Freshman Chemistry Experiment. Lawrence L. Garber, George V. Nazaroff

3:05 346 Development of and Expectations from a Microscale Experiment for the Determination of the K_a of a Weak Acid. Marcia L. Gillette, H. A. Neidig

3:25 Break

3:35 347 Micro and(or) Semimicro Organic Laboratory? Bruce N. Campbell, Jr.

3:55 348 Synthesis of an Isolable Quinodimethane. Stuart Rosenfeld, Sarah VanDyke. WITHDRAWN

4:10 349 Preparation of Rare-Earth and Yitrium Garnets: A Solid State Chemistry Experiment. R. H. Langley, N. Nordoff, T. Calcaterra, R. Lancaster, R. Beaty

4:30 350 Laser Experiments in Undergraduate Chemistry: A Practical Guide. Jack K. Steehler

4:50 351 Colorimetric Estimation of Glucose Using Low-Cost Colorimeter an Under Graduate Experiment. P. K. Sai Prakash

5:10 352 Enzymatic Estimation of Non-Reducing Sugars by Using Low-Cost Colorimeter. P. K. Sai Prakash

Poster Session: Tests and Trends, Freshmen and Advanced Courses
2:00 - 5:00 Student Center, 320 + 321

353 Taking Tests and Learning Chemistry: Phase II. Mark B. Freilich

354 Undergraduate Research as a Writing Intensive Course for the Generally Educated Chemistry Student. Richard L. Petersen, Mark B. Freilich

355 Toledo Placement Test versus California Diagnostic Test. V. H. Crawford

356 Trends and Predictions: Freshman Chemistry Grades at a Military College. Thomas H. Richardson

357 Freshman Chemistry - How To Begin? Organic Chemistry as the First Course. R. G. Scamehorn, J. W. Beatty, Jr.

358 A Laboratory Course for Analytical, Organic and Physical Chemistry: Integrated, Intergenerational and Interdisciplinary. David MacInnes

359 Spread Sheets in the Quantitative Analysis Laboratory. Albert Schlueter

360 Computers in Undergraduate Physical Chemistry. Mundiyath Venugopalan

Thursday Morning, August 9

Plenary Session — Omni, Convention Center
Beth Pulliam, Presiding — Ballroom Level

8:00 361 Designing New Chemistry Courses, Curriculum Structures, and Teaching Strategies, K-12 -- For the Decade of the 1990's. Marjorie Gardner

FIPSE FOLLOW-UP SYMPOSIUM: Teaching with Today's Technology - Introductory Chemistry (Ticket required; limited enrollment; see Workshop No. 29 for description.)
John Moore, Presiding — Weber (SST), Upper

9:30 104 Introduction to the FIPSE Follow-up Symposium. John W. Moore

9:40 362 Illustrating the Rutherford Alpha Particle Scattering Experiment with the Computer Program "Alpha Scatter". Frank W. Darrow

10:00 Concurrent Sessions

363 Using a Column Calculator in General Chemistry Laboratory. Steven Gammon, Gery Essenmacher

364 Going Beyond the Game Paddle Port in Chemistry. Robert Alan Shaner. WITHDRAWN

365 A Simple Computer-Interfaced Equilibrium Experiment. Teresa Anderson, Steven Gammon, Gery Essenmacher

107 KC?Discoverer as a Classroom Catalyst. Karen E. Eichstadt, Peter J. Tandler, Douglas C. Rader

12:00 Wrap Up Session

What's Hot in Science Education Research
Ken Tobin, Presiding — Weber (SST), L1

9:30 366 Teaching Chemistry: Strategic Clues from the Structure of Knowledge. Richard A. Duschl

10:00 367 Thinking Chemistry, Talking Chemistry and Doing Chemistry: The "Chemistry" of Chemistry Teaching and Learning. Antonio Bettencourt

10:30 368 Problem Solving in Chemistry and Education: Psychological and Sociological Aspects. Craig W. Bowen

11:00 369 High School Chemistry: Reasons Underlying Teachers' Classroom Practices. James J. Gallagher, Thomas Yocum, Ruthann Schulke

11:30 370 Alternative Assessment in Science Education. Anthony Lorsbach

12:00 371 Enhancing the Quality of Science Learning and Teaching. Kenneth Tobin

Chemistry in the Toy Store (2 hours)
David Katz, Presiding — Howey (Physics), L2

9:30 372 Chemistry in the Toy Store. David A. Katz

Software for the One Computer Classroom
Paul Cauchon, Presiding — Boggs (Chemistry), B6A

9:30 373 Using Cricket Graph for Analysis of Laboratory and Classroom Data. Diana Malone

10:00 374 Interfaced Experiments in a General Chemistry Lab with One Macintosh SE. Annamaria Fulep-Poszmik, Sally Solomon

10:30 375 Computer Analysis of Laboratory Data by Freshman Chemistry Students. C. A. Baker

10:45 376 IR/NMR Spectroscopy. Kathryn Stone Bailey

11:00 377 Helping Students Master the Six-Solution Problem. Helen M. Stone, Ben L. Smith

11:15 378 Mole Demo II, A New and Much Improved Version of an Old Favorite. Lee R. Marek

11:30 379 Illustrating the Rutherford Alpha Particle Scattering Experiment with the Computer Program "Alpha Scatter". Frank W. Darrow

11:50 380 Periodic Tableworks and Other One-Computer Classroom Gems. Tamar Y. Susskind

12:10 381 One Computer Classroom - Chemistry, Environmental and Physics. Patricia C. Flath

Cosmic Chemistry
Leo Kling, Presiding — Weber (SST), L2

9:30 382 Seeing the Stars: Then and Now. U. Lee Barnwell, Jr.

10:00 383 Electromagnetic Techniques for Characterization of Planetary Atmospheric Constituents. Paul G. Steffes

10:30 3844 Molecules in Interstellar Space. M. M. Graff

11:00 385 Laboratory Experiments and Cometary Science. R. L. Hudson

11:30 386 Cosmochemistry and the Origin of Life: Miller-Urey Revisited. Clifford Matthews

12:00 387 Chemistry and the "Final Frontier". David J. Crouse, Paul B. Kelter

Chemical Resources in Museums
David Ucko, Presiding — Howey (Physics), L4

9:30 388 Chemistry in Science Museums. David A. Ucko

10:00 389 Hands-On Chemistry at a Science Museum. Dennis Drobeck

10:30 390 Taking the Mystery Out of Chemistry. Chuck O'Connor

11:00 391 American Chemical Society Pursuits in Chemistry for Museums. R. E. Laber

11:30 392 Enhancing Public Understanding of Science with Ping-Pong Rocket, Crystal Spider, and Other Hands-On Chemistry Exhibits. Suzanne Ullensvang, Ilan Chabay

Artificial Intelligence, Expert Systems and Intelligent Tutors. I. Behind the Scenes
Catherine Middlecamp, Presiding — Boggs (Chemistry), B6

9:30 393 Artificial Intelligence - What It Is and Isn't. Arthur A. Eggert

10:00 394 How Do You "Model" a Student? Elizabeth Kean

10:30 395 KC Expert and KC Tutor: A Natural Language Interface to a Chemical Database Plus an Intelligent Tutor. W. F. Coleman, G. Scott Owen

11:00 396 What's in a Name? Two Experts for Chemical Literacy. Arthur A. Eggert, Catherine Middlecamp

11:30 397 Development of an Expert System. James P. Birk

12:00 398 Build Your Own Expert System? Frank A. Settle, Jr.

High School/Middle School Teacher Education
Angela O. Bedenbaugh, Presiding — AECAL (Chemistry), 17

9:30 399 Project Interaction: An Effective Model for the Continuing Education of High School Chemistry Teachers. Daniel J. Antion, Sondra F. Wieland

10:30 400 College Faculty Can Influence High School Chemical Eduction -- The Mississippi Experience. John H. Bedenbaugh, Angela O. Bedenbaugh

10:55 401 Helping High School Students by Updating Their Teachers. Alan J. Pribula, Nordulf W. G. Debye, Frank R. Milio

11:20 402 Bridging the Gap Between Secondary Schools and College: The Millsaps College-HHMI Co-Sponsored Summer Research Institute. Johnnie-Marie Whitfield, C. Eugene Cain

11:40 403 A Chemistry/Physics Course for the Preparation of Middle School Science Teachers. Scott McRobbie, Nicholas Zevos

11:55 404 The Use of Computers in a Beginning Chemistry Laboratory. Nicholas Zevos, Bruce N. Campbell, Jr.

The Traveling Chemistry Demonstration Presentation
Tom Greenbowe, Katie Stygall, Presiding AE AL (Chemistry), 16

9:30 Introductory Remarks

10:00 405 Traveling Chemistry Demonstrations - More Than Meets the Eye. Ron I. Perkins

10:30 406 Adding Organic and Biochemistry to Introductory Courses. Jerry A. Bell

11:00 Break

11:30 407 Science in a Suitcase. V. R. Wilcox

12:00 408 Administration Details of the Traveling Chemistry Demonstration Presentation. Thomas J. Greenbowe, William L. Dills, Jr., James A. Golen

Poster Session: General Posters
9:30 - 12:30 Student Center, 320 + 321

409 Chemical Equilibrium Revisited - To MINSQ or not to MINSQ. Clare T. Furse

410 Calculations for Percentage Composition of a Mixture Using an Apple II Computer. R. D. Ford

411 Integrating Descriptive Chemistry into the High School Chemistry Curriculum. Mundiyath Venugopalan

412 A Report on Chemistry Activities at the National Science Olympiad Tournament, May 18-19, 1990. C. L. Bering, S. Zamzow, W. Krugh, G. Wollaston, F. Keen

413 The North Louisiana Science Improvement Project. William C. Deese, Carolyn Talton

414 Preparing Minority Students for Science Careers - A Success Story. Albert Schlueter

415 Establishing Links Between High School and Pre-High School Science Teachers through Chemical Demonstrations Workshops. Richard L. Petersen, Mark B. Freilich

416 JHSci-Training for Middle School Science Teachers. David J. Crouse, Margaret Phelps, Linda McGugin, Jerry Ayers

417 Industrial Uses of Chemistry: A Pre-College Teacher Workshop. Arlyne M. Sarquis, John P. Williams

418 Improving the Understanding of Chemistry by Updating Bonding. Robert T. Sanderson, Henry Heikkinen

Thursday Afternoon, August 9

FIPSE FOLLOW-UP SYMPOSIUM: Teaching with Today's Technology - Introductory Chemistry (Ticket required; limited enrollment; see Workshop No. 29 for description.)
John Moore, Presiding — Weber (SST), Upper

2:00 104 Introduction to the FIPSE Follow-up Symposium. John W. Moore

2:10 362 Illustrating the Rutherford Alpha Particle Scattering Experiment with the Computer Program "Alpha Scatter". Frank W. Darrow

2:30 Concurrent Sessions

363 Using a Column Calculator in General Chemistry Laboratory. Steven Gammon, Gery Essenmacher

364 Going Beyond the Game Paddle Port in Chemistry. Robert Alan Shaner. WITHDRAWN

365 A Simple Computer-Interfaced Equilibrium Experiment. Teresa Anderson, Steven Gammon, Gery Essenmacher

107 KC?Discoverer as a Classroom Catalyst. Karen E. Eichstadt, Peter J. Tandler, Douglas C. Rader

4:30 Wrap Up Session

The Traveling Chemistry Demonstration Presentation (See Workshop No. 14 for details.)
Tom Greenbowe, Katie Stygall, Presiding — AECAL (Chemistry), 16

2:00 419 Activities from WonderScience Magazine. Ann E. Benbow

2:30 420 Safety and Legal Issues Associated with Presenting. Jim Kaufman

3:00 Hands-On Workshops

A Sampling of NSF Funded Chemistry Projects in Teacher Preparation and Enhancement
Ethel Schultz, Presiding — Howey (Physics), L2

2:00 421 Physics and Physical Science Teaching: A Model for Excellence. D. A. Berry, D. D. Long, R. L. Bowden, T. G. Teates

2:30 422 Instituting Change: Programs for Enhancement of Science and Mathematics Teaching. Carlo Parravano

3:00 423 Teaching Elementary Physical Science. Doris K. Kolb, A. Donald Glover

3:30 424 Enhancing 9th Grade General Science Teachers Chemistry Background. L. R. Summerlin, L. K. Krannich

4:00 425 ChemSource: A New Support Strategy for Chemistry Teaching. Mary Virginia Orna

4:30 430 NSF-Program in Teacher Preparation and Enhancement. Ethel L. Schultz

The History of Chemistry Sets
George Gilbert, Presiding — Howey (Physics), L3

2:00 Introductory Remarks

2:10 427 The History of the Chemistry Set. W. B. Jensen

2:55 428 Experiments in Chemistry Sets. David A. Katz

3:40 429 Chemistry Sets and the Popularization of Chemistry. David J. Rhees

4:25 430 The Impact of Chemistry Sets - Anecdotes and Statistics. George L. Gilbert

Videodisc Applications
Alton J. Banks, Presiding — AECAL (Chemistry), 17

2:00 Introductory Remarks

2:05 431 Interactive Video Techniques for the Teaching of Chemistry. Stanley Smith, Loretta Jones

2:50 432 FT-NMR Problems: An Innovative Videodisc-Based Instructional Tool. Arlene A. Russell, Orville L. Chapman

3:35 433 The Birth of a Videodisc. Mike King

4:20 434 The Periodic Table Videodisc and Beyond. Alton J. Banks

Pre-High School Science Outreach
Christie Borgford, Presiding — Mason (CE), 142

2:00 435 Students Teaching Students, a Variation of Cooperative Education. W. S. Vitori

2:35 436 PACTS in Sacramento. L. Borer, L. Zarzana

3:00 437 World of Wonder: The Chemistry of Metals. James P. Deavor

3:15 438 The Other End of the Pipeline--Promoting Children's Interest in Chemical Industry. Christie Borgford, Alan Marsden

4:05 439 Operation Smart - A Program to Encourage Every Girl in Science, Math and Relevant Technology. C. L. McKenzie, C. T. Sears, Jr.

4:30 440 Adopt a Class - Our Experiences and Impressions. J. L. Langton, S. M. Wright

Artificial Intelligence, Expert Systems and Intelligence Tutors. II. Play Ball!
Catherine Middlecamp, Presiding — Boggs (Chemistry), B6

2:00 441 An Expert System for Sophomores in Organic Chemistry. Joyce C. Brockwell, John H. Werner, Stephen J. Townsend, Nim H. Tea

2:30 442 Problem Solving in Chemistry via an Intelligent Tutoring System. Zavaha Scherz

3:00 443 Predicting Inorganic Reactivity: Expert System. James P. Birk

3:30 444 CHEMPROF: An Intelligent Tutor for General Chemistry. Catherine Middlecamp, Arthur A. Eggert, Elizabeth Kean

4:00 445 A Little Expert Goes a Long, Long Way. John S. Martin, Edward V. Blackburn

4:30 446 KC?Discoverer: A Chemical Microworld Based on Artificial Intelligence, Videodisc, and Computer Technology. John W. Moore, Daniel Cabrol

Educational Application of Spreadsheets
D. M. Whisnant, Presiding — Boggs (Chemistry), B6A

2:00 447 Spreadsheet Analysis of Student Lab Data. Paul A. Cauchon

2:20 448 Spreadsheets and Data Base Management Applications. Patricia C. Flath

2:40 449 Using Database Managers: As Easy as A-B-C. Larry M. Wier

3:00 450 Spreadsheet Calculations in General Chemistry. G. L. Breneman, O. J. Parker

3:20 451 Vaulting the Arithmetic Barrier is as Easy as 123. Henry Freiser

3:40 452 Using Equation Solvers, Spreadsheets, and Other Software with Freshmen Learning Chemistry in a New Integrated Engineering Curriculum. Allan L. Smith

4:00 453 Using Equation Solving Software to Solve Simultaneous Equations and Teach Mathematical Modelling in the Undergraduate Chemistry Curriculum. William F. Coleman

4:20 454 Using Spreadsheets to Solve Schrodinger's Equation. Frank Rioux

4:40 455 Using Spreadsheets to Teach Biochemistry. Sandra I. Lamb, Daniel E. Atkinson

Chemical Competitions (1/2 session)
Penney Sconzo, Presiding Mason (CE), 142A

2:00 456 Chemical Competitions. Margaret Christoph, Glenda Epperson

Reform In Science Education
Penny Gilmer, Presiding Boggs (Chemistry), 2-28

2:00 457 Science for All: Forging the Future of Science. Audrey B. Champagne

2:30 458 Encouraging Women to Enter and Remain in the Sciences: Proactive, Unified Efforts. Linda S. Dix

3:00 459 Practice and Teaching of Science to Students of All Ages. Samuel Devons

3:30 460 Discussion of Ethics and Values in University Science Courses. Penny J. Gilmer, Paul R. Elliott

4:00 461 Partnership Programming and Creative Coalitions. Sylvia A. Ware

4:30 462 Training Minority Teachers. Frederick Humphries

Teacher Education Programs
Jeff Pribyl, Presiding Student Center, 301

2:00 463 Teachers Teaching Teachers: National Chemistry Week Activities. Daniel J. Antion, M. Louise Floyd, Sondra F. Wieland

2:50 464 Explorations in Chemistry: Teachers Teaching Teachers. Dianne N. Epp

3:15 465 Hands-On Science Activities. S. J. Baum

3:40 466 Elementary Mathematics and Science Institute: A Successful Summer Program Involving the Cooperation of Several Academic Departments. Jeffrey R. Pribyl

4:05 467 Chemistry Workshops for Elementary Teachers. Gerald R. Franzen

4:20 476 The Five Hundred Hats: Directing the General Chemistry Program. Patricia L. Samuel

Learning Styles and Misconceptions
Trish Metz, Presiding A. French 101

2:00 468 Learning Styles vs. Achievement in Chemistry: Grade 13. William H. McMahan

2:20 469 Use of the Learning Cycle to Promote Cognitive Development. Mary Ann Davison, J. D. Herron

2:35 470 A Guided Design Problem-Solving Laboratory Program. Patricia A. Metz

3:05 471 Problem Categorization - A Learning Theory-Based Problem Solving Approach. Diane M. Bunce, Dorothy Gabel

3:25 472 Chemistry Problem Solving -- The Explicit Method. Diane M. Bunce

3:45 Break

3:50 473 Activation Energy and Chemistry Learning: Alternative Conceptions of Student Teachers-Implications for Science Instruction. A. F. Cachapuz, I. P. Martins

4:10 474 Understanding Chemical Equilibrium. Robert B. Kozma, Joel Russell, Jerome Johnston

4:30 475 Applied Chemistry Misconceptions that Survive the General Chemistry Course. John W. Judkins

001 FUTURE CHEMISTRY: EXPANDING FRONTIERS VS. CONSTRAINED RESOURCES. Mark Wrighton, MIT, Cambridge, MA. 02139.

002 BRASTED LECTURE: CHEMICAL EDUCATION FOR THE INTERNATIONAL TRANSFER OF KNOWLEDGE AND TECHNOLOGY. Aleksandra Kornhouser, International Centre for Chemical Studies, University of Edvard Kardelj Ljubljana, Vegora 4, 61001 Ljubljana, Yugoslavia.

003 HOW TO OBSERVE A CHEMICAL BOND. B. Crawford, Jr., Department of Chemistry, University of Minnesota, Minneapolis, MN 55455.

The laws of physics and the magnitudes of the universal constant, operating on the molecular scale, result in certain chemical reactivities and also in certain mechanical and structural properties; the procedures of epistemology applied to molecules result in the energies, bond angles, and bond force constants and hence bond frequencies. The consequence is that, of all the observations which can be made on a chemical system, the infrared spectrum yields information most perspicacious in chemical terms. Other papers in this symposium will show the ease of use of modern IR, and the astonishingly general adaptability of the technique, and hence its enormous value in the characterization of substances. We shall discuss the value of IR as a direct way of showing what the concept of the chemical bond means, and its relation to a chemical understanding of molecular structure.

004 **FOURIER TRANSFORM AND LASER TECHNIQUES: THE RENAISSANCE OF VIBRATIONAL SPECTROSCOPY.** **I.M. Mills, Department of Chemistry, University of Reading, Reading RG6 2AD, U.K.**

Fourier transform spectroscopy, laser spectroscopy, and the computer control of instrumentation and data handling, have revolutionised and rejuvenated vibrational spectroscopy in the last 15 years. The improvements in the performance of modern instruments may span several orders of magnitude in stability and signal/noise levels, sensitivity, resolution, and speed of data acquisition and handling. The principles behind these changes will be described, with examples.

The application of these developments to the study of high overtone spectra of small atmospheric molecules in the near infrared will be described, as represented by current research in the author's laboratory. Our experimental work ranges from very high resolution Fourier transform spectra of low-pressure gasses to dye-laser photoacoustic spectra, sometimes using high pressure hydrogen gas Raman shifter to move from the visible to the near infrared.

005 RAMAN AND INFRARED (IR) SPECTROSCOPY - COMPLEMENTARY TOOLS IN SCIENCE AND TECHNOLOGY

Bernhard Schrader, Institute of Physical and Theoretical Chemistry, University of Essen, GFR

Raman and IR spectroscopy supply complementary images of the vibrational spectrum of molecules and molecular aggregates. In IR spectra, vibrations of the polar groups and antisymmetric vibrations are predominant; in Raman spectra, however, the vibrations of non-polar groups and symmetric, selection rules describe which vibrations may be seen in which spectrum. For scientific problems, it is advisable to investigate both spectra because of the collective benefits. There are also practical reasons: water is a good solvent for Raman spectroscopy; fiber optics can be applied easily; and spectra can be run from sensitive or precious material in closed containers. IR spectroscopy has been the routine method, which could be applied to many kinds of samples, where Raman spectra (excited with radiation from the visible range of the spectrum) could not be run because of the problems of absorption or fluorescence. New Raman spectrometers have been developed recently, which use exciting radiation in the near infrared. By employing Michelson interferometers and the Fourier transformation of the interferograms, Raman spectra of engineering or biological samples can be recorded without fluorescence interference. For many applications, miniature spectrometers allow nondestructive real-time monitoring of on-line industrial processes. Distant analyses are possible with fiber optics or by dedicated miniature spectrometers. Although the effect is small, and difficult to measure, chiral molecules and aggregates give information about structural properties by the optical activity of their vibrations in Raman and IR spectra. Structural problems may often be solved by combination of experimental spectra with simulated ones by model calculation of the frequencies and intensities.

006 FOURIER TRANSFORM RAMAN SPECTROSCOPY

Robert Hannah, Perkin Elmer Corp., Bruce Chase, E.I. DuPont de Nemours

Raman spectroscopy has historically been a poor performing analytical tool in an industrial spectroscopy laboratory. While it might provide complementary information to infrared and in some cases provide for easier sampling, the majority of samples exhibit a background fluorescence which totally swamps the Raman signal. Many approaches have been tried in an attempt to minimize this problem, but the only universal solution is to reduce the energy of the incoming photons to below the threshold for excitation of the electronic process which gives rise to the fluorescence. This has been the driving force behind the development of near infrared Raman spectroscopy.

The basic experimental requirements for the FT-Raman experiment will be reviewed and possibilities for further improvements will be pointed out. The potential for FT-Raman techniques will be illustrated with examples taken from industrial problems. Currently, the sensitivity of the FT-Raman experiment is not limited by detector noise, but by spectral artifacts. The source of these artifacts will be discussed. Finally, there are new detectors available which extend the range of the multi-channel detection further into the infrared. Preliminary information on these detectors indicates that they may provide another alternative for the Raman spectroscopist.

007 GLOBAL WARMING - THE GREENHOUSE EFFECT, Chad A. Tolman, Central Research & Development Department, Du Pont Experimental Station, Wilmington, Delaware 19880-0328.

Global warming caused by the greenhouse effect has been called the second greatest threat to humankind after nuclear war. What is the greenhouse effect, and how does it work? What could happen if computer models of human impact on the global atmosphere are correct? How am I contributing to the problem? How can I contribute to a solution?

An 11-minute video produced by the Union of Concerned Scientists, *Greenhouse Crisis: The American Response*, will be shown as background. Some of the uncertainties associated with predictions of future effects will be described, along with estimates of CO_2 released to the atmosphere by various types of human activities.

008 HAZARDOUS WASTES - WILL WE EVER SEE THE END OF THEM? Glenn Paulson, Ph.D. IIT Center, 10 West 35th Street, Chicago, IL 60616.

Partly a result of more sensitive analytical tools, partly an unintended result of air and water pollution control, and partly a result of an "out of sight-out mind" attitude, our nation's hazardous waste problem is immense. There are two major pieces of the problem: 1) the legacy from the past and 2) the current and future creation of new hazardous wastes.

Regarding the legacy of abandoned sites, the pace of cleanup has been slow. This has been due to several factors, including an inadequate commitment of research and development resources, an overly-cumbersome regulatory approach, and inconsistent legislative signals; overarching this is the sheer scope of the problem. Improvements are possible, some in the technical realm and others in non-technical areas.

Regarding current and future production, the most constructive path is the path of waste reduction, since the only alternative is to increase the legacy from the past faster than we can clean it up.

009 CFCs AND OZONE: INDUSTRY LEADERSHIP IN ENVIRONMENTAL PROTECTION. J. M. Steed, C & P Department, E. I. du Pont de Nemours & Company, Wilmington, DE 19898

From the original suggestion in 1974 that CFCs might deplete stratospheric ozone through the international agreement embodied in the United Nations Environment Programme's Montreal Protocol in 1987 and beyond, the "ozone issue" has been a unique concern. The relationships that grew among industry, academia, governments, and environmental groups permitted and unprecedented global approach first to scientific research and later to responsible action. A short history of the issue will be presented from the viewpoint of an active participant, with emphasis on the role of industry in developing the science that led eventually to a planned phaseout of worldwide CFC production. In particular, ozone depletion will be discussed as a model for responsible handling of scientifically complex environmental concerns.

010 EDUCATION FOR NEW TECHNOLOGY

Presiding: A. J. Cunningham, Agnes Scott College, Decatur, GA 30030

Presentations:

(1) "Scanning Tunneling Microscopy And Other New Approaches For Characterizing And Fabricating Integrated Chemical Systems." Allen J. Bard, Department of Chemistry, University of Texas-Austin.

(2) "New Educational Insights Facilitated By Biomolecular Engineering Successes." C. Anthony Hunt, Department of Pharmaceutical Chemistry, University of California-San Francisco.

Panel: Allen J. Bard, C. Anthony Hunt, Bassam Shakashiri, Mark Wrighton

The education of scientists for Wrighton's "Future Chemistry" is a complex issue shaped by new knowledge and challenges at the interfaces of chemistry with physics, materials science and molecular biology. Educational advantages accrue from using concepts and information gained by new technology. Teaching toward an expanded, more integrated view of chemical sciences is actually facilitated. Thus, education informed by new technologies guides education for new technologies.

011

"It's Analytical My Dear Watson!" A NSF supported Young Scholars Program in Forensic Science for Talented High School Students, Rosette M. Roat, Department of Chemistry, Washington College, Chestertown, MD 21620.

It's Analytical My Dear Watson!", The Forensic Science Project, is supported by a Young Scholars Program grant from the National Science Foundation. The project promises a select group of advanced high school students an intense multi-disciplinary experience in forensic chemistry, scientific ethics, psychology, criminalistics, and criminology. Fifteen high school students are selected with the assistance of the applicants' local science teachers and counselors. The project meets on the campus of Washington College for a two week summer residential program. Students are challenged with advanced scientific and humanistic theory coupled with practice in research methodology. Lecture sessions provide the theory of "wet" and instrumental chemical analytical methods and pose chemical and criminal puzzles. In the laboratory, student sleuths begin with fingerprinting and blood typing and work up to the use of the Washington College Chemistry Department's research grade instrumentation for the analysis of blood alcohol using the chemistry of the breathalyzer test and analysis of arson materials using gas chromatography.

012

DEMONSTRATIONS OF FORENSIC SCIENCE TECHNIQUES. A VIDEOTAPED SERIES FOR THE ENHANCEMENT OF HIGH SCHOOL AND COLLEGE/UNIVERSITY SCIENCE COURSES. E. J. Nienhouse, Department of Physical Sciences, Ferris State University, Big Rapids, MI 49307

Both upper division high school science courses and lower collegiate level introductory courses have profited from an increasing emphasis on applied science. Indeed, many schools have chosen to offer an introductory course in forensic science as an interesting and exciting vehicle for effectively communicating the nature of science, particularly chemistry and biology. But, because many such introductory courses are taught without a laboratory component, students enrolled in these courses are often unable to visualize the scientific techniques used routinely in the crime laboratory. Excerpts from the video-taped series mentioned in the title will serve to illustrate the author s attempt to design a laboratory/ lecture and demonstration format wherein the student becomes an active participant in "laboratory/ discovery"exercises which vividly illustrate those scientific techniques used by practicing criminalists. Topics covered in the videotaped series are: acid/base concepts encountered in forensic science, analysis and identification of drugs by color tests and TLC, chromatographic separations and the use of the gas chromatograph, firearms evidence examination, forensic microscopy, pathology, and serology. The scenario-based exercises provide students with the opportunity of catching something of the excitment of identifying the most likely suspect in the case under investigation or reaching some conclusion regarding the significance of the evidence being analyzed.

013 FORENSIC CHEMISTRY EXPERIMENTS YOUR KIDS CAN DO. K.O. Berry, Department of Chemistry, University of Puget Sound, Tacoma, WA 98416.

Forensic chemistry provides one of the most obvious areas of applied chemistry that can be recognized by people of all ages. Because successful forensic work is so intimately related to processes of observation and deduction, there are many activities that can be successfully completed by young kids as well as older individuals. Further, these activities can be even more interesting when placed in a setting of case studies, with appropriate story lines. Activites will be described that are suitable for middle school and upper-elementary students, including chromatography, density, recognition of odors, chemical separations, use of microscope and hand lenses, fingerprinting, comparison of typewritten samples, and others. In addition to the presentation, hand-outs will be available so that participants can take suggested experiments with them.

014 TEACHING DNA FINGERPRINTING TECHNIQUES IN A FORENSIC SCIENCE COURSE FOR CRIMINAL JUSTICE MAJORS. H.E. Outlaw, Department of Chemistry, Delta State University, Cleveland, MS 38733.

Because of its ability to individualize a suspect, the analysis of deoxyribonucleic acid (DNA) is rapidly becoming a powerful tool in the forensic sciences. Presently, DNA analsis of biological material (also called DNA fingerprinting or profiling) has been introduced in over 100 American cases and about 50 in Britain. Also many paternity cases have been settled with this technique. While the steps and interpretation of the procedures are part of the standard vocabulary of students in molecular biology and biochemistry, those in criminal justice programs are typically bound by a limited scientific background. Yet, these students will eventually wind up as criminal investigators, lawyers, judges, and may well be asked to grapple with double helix models, southern blots and restriction fragment length polymorphism analysis. Accordingly, this talk will focus on successful pedogogical approaches which have been developed to present DNA fingerprinting techniques and interpretation of results to students with minimum scientific background.

015 FORENSIC MICROSCOPY. Larry Peterson, Division of Forensic Sciences, Ga. Bureau of Investigation, Decatur, Georgia, 30037

This presentation will describe the use of microscopy to aid the criminal justice system in criminal casework. Many criminal activities result in the transfer of trace amounts of material from person-to-person, object-to-object, or object-to-person. The microscope is used to detect these transfers. The Wayne Williams murder case will be highlighted as an example where analysis of trace amounts of textile fibers played an important role.

016 THE ACADEMIC PROGRAM OF THE INSTITUTE OF PAPER SCIENCE AND TECHNOLOGY.
T. J. McDonough, Institute of Paper Science and Technology, Atlanta, GA 30318

The paper industry is faced with a critical requirement for scientists and engineers who are both highly skilled in their own fields and broadly conversant with the industry's technology and specialized needs. The Institute of Paper Science and Technology has as its principal academic mission the fulfillment of that need.

Students are selected from engineering and science programs at leading universities across the country according to stringent entrance requirements. Successful applicants become the focus of multi-disciplinary Master's and Ph.D. programs that are couched in a unique environment. This paper will describe the program's curricular components, and their relationship to a number of conceptual elements that define it. Both will be discussed in terms of their relevance to the changing industrial environment and the strengths that will be derived from the Institute's recently forged alliance with the Georgia Institute of Technology.

017 APPLICATIONS OF BIOTECHNOLOGY TO FORESTRY.
D. T. Webb and R. J. Dinus, Department of Chemical and Biological Science, Institute of Paper Science and Technology, 575 14th Street, N.W., Atlanta, GA 30318.

The Forest Biology group at the IPST were pioneers in the use of somatic embryogenesis to regenerate clones of spruce. Present efforts are concentrated on extending this technology to loblolly pine and Douglas fir which are the two most important timber species in the USA. Suspension cultures are being used to develop freezing tolerance in larch cells, and the use of cryopreservation to store valuable germplasm is on the horizon. Eastern cottonwood is being cloned using micropropagation from leaves. This technique will be used to transform cottonwood with valuable foreign genes. Cottonwood cell cultures may also be used to produce herbicide tolerant trees.

018 PULPING AND BLEACHING CHEMISTRY.
D. R. Dimmel, Institute of Paper Science and Technology, 575 14th Street, N.W., Atlanta, Georgia 30318

The principal way in which wood is converted to paper in the U.S. is by the kraft process. The first stage of this process involves treating wood chips with a highly alkaline aqueous sodium sulfide solution at 170°C to get "pulp." Here the chemicals are acting on the wood to remove one polymer, lignin, while retaining another polymer, cellulose. The small amount of lignin remaining in the pulp can be removed by "bleaching" with chlorine and oxygen-based chemicals, such as hydrogen peroxide, to provide a white paper product. The yield of bleached pulp, however, is only about 45%. Utilization and treatment of the by-product is an intergal part of the papermaking process. There are several sets of interesting organic and inorganic reactions occurring in the pulping, bleaching, and by-product areas.

019

WET END CHEMISTRY, Robert A. Stratton, IPST, 575 14th St., N.W. Atlanta, GA 30318

At the wet end of the paper machine a variety of chemicals are added to the slurry of cellulose fibers in water. These chemicals either improve the papermaking process or provide particular properties to the end product. They may be of low molecular weight or polymeric, soluble or insoluble in water. Reactions forming either ionic or covalent bonds occur between the additives and the fibers to give such properties as: brightness, color, water or grease repellancy, opacity, and wet strength. The physical and chemical principles underlying the interactions of the additives with the fibers will be discussed.

020

PAPERMAKING AND PAPER PRODUCTS, John F. Waterhouse, IPST, 575 14th St., N.W. Atlanta, GA 30318

Most people are surprised to learn of the technological scientific depth and breadth associated with papermaking. Papermaking is still both an art and a science, and is truly multidisciplinary involving not only biology, chemistry and chemical engineering, but mathematics, physics, engineering and materials science.

This presentation will give an overview of papermaking science, including the areas of stock preparation, sheet-forming, wet-pressing and drying. Papermaking, however, does not end with the reel of paper produced on the papermachine. In most cases some form of converting process is required to produce the final paper product. Therefore, this talk will conclude with a brief examination of one or two paper products and the converting processes involved in their production.

021 DEMONSTRATIONS, NOVEL AND EASY. I. Talesnick, Faculty of Education, Queen's University, Kingston, Ontario, Canada K7L 3N6.

During this hour, demonstrations which are not only fun, but also introduce and illustrate important concepts will be performed.

022 DAZZLING DEMOS AND CHEMICAL BLOOPERS: A VIDEOTAPE COLLECTION. John J. Fortman, Department of Chemistry, Wright State University, Dayton, OH 45435.

Through the years I have collected and edited many misadventures which Rubin Battino and I experienced in doing demonstration shows which were videotaped live. Difficulties incountered in the studio preparation of our three hour set of videotaped demonstrations were also saved. These will make up one half hour of these showings. Gil Haight has given me permission to show portions of his "Haightful Perils of Teaching" which are spectacular in spite of technical problems. A videotape of Hubert Alyea's doing his "Old Nassau" demonstration will be shown and possibly some tapes of others caught in live demonstrations which presented problems.

023 CONCRETE: DELICATE CHEMICAL REACTIONS PRODUCE MACROSCOPIC PRODUCTS. Gladysmae C. Good, Arlington High School, Indianapolis, IN, 46226

One tends to think of concrete as a construction material but it has its being in chemistry. The production of concrete on the laboratory scale is an interesting tool to teach heterogeneous mixtures, their optimum composition, the effects of temperature, impurities, and mixing on the properties of the final product. Hydrolysis and bonding can be illustrated by varying the composition and conditions. With the demand for new materials for construction in space as well as on earth concrete will play a major role in satisfying needs of today and tomorrow.

Included in the presentation will be the chemistry of concrete, instructions for making concrete, how to vary the composition to produce different properties, projections for the future of concrete and how to generate interest in a familiar product in the unexpected setting of a high school chemistry laboratory.

024 MORE "FUNKY" SCIENCE 'SPEARMENTS

Patrick E. Funk
Watkins Memorial High School
8868 Watkins Road SW
Pataskala, Ohio 43062

This demonstration workshop will present a variety of low-cost, easy-to-do Physical Science demonstrations. Funky will show his latest science teaching innovations. These classroom-proven demonstrations are designed to assist students in mastering the abstract concepts of Chemistry and Physics. All demonstrations will be fully described in the accompanying handout. Join us for this fun science experience!

025 A BEGINNER'S GUIDE TO INTERFACING: TIPS, TRICKS, AND PITFALLS. James C. Swartz, Department of Chemistry, Thomas More College, Crestview Hills, KY 41017

The area of computer interfacing to laboratory instruments will be discussed from a beginner's perspective. Topics which will be discussed include: how to get started, building vs purchasing interface circuits, timing of signals, and writing software. Specific details will be given pertaining to interfacing an Apple IIe computer to a Varian EM-360 NMR. Results from signal averaging and integration will be presented.

026 INTEGRATING COMPUTERS INTO SCIENCE INSTRUCTION: INVOLVING STUDENTS IN THE PROCESS OF SCIENCE. J.R. Amend and R.P. Furstenau, Dept. of Chemistry, Montana State University, Boseman, MT 59717

Computers are used in science teaching today for something they do very well--tireless drill and diagnostic review. Integration of the personal computer into the instructional laboratory, however, can enhance the problem solving, data acquisition, and data analysis aspects of the teaching and learning of science as much as the word processor has enhanced writing. When properly used, computers can involve students in experiment design, and can change the way we teach science.

This paper will describe a project which has resulted in the design and installation of sixty PC=based laboratory workstations in our freshman chemistry laboratories. These workstations have been in service for three years, and serve about 1200 students per week. They provide all of the electronic data acquisition required in lower division science classes--temperature to 0.01^{o}C, pH to 0.01 pH unit, light, voltage, current, nuclear counts, and time to 100ms.

027 COMPUTER INTERFACING: MAKING OLDER INSTRUMENTS WORK LIKE NEWER MODELS George C. Lisensky, Dept. of Chemistry, Beloit College, Beloit, WI Specific examples will be discussed where we use computer interfacing to enhance the capabilities of older instrumentation. 1) For instruments that provide TTL logic signals, such as a Beckman Acculab Infrared Spectrometer, we use an Apple computer with an ADALAB board (Interactive Microware, Box 139, State College, PA 16804) and the RECORD/RECALL programs (Project SERAPHIM) for event-driven data acquisition. Spectra are stored on disk and recalled for overlays and peak asignments. 2) For instruments with only an analog voltage output, such as a Spectronic 20 or a Perkin-Elmer 360 Atomic Absorption Spectrometer, we use an Apple computer with a DATACARD board and GraphSPEC programs (Anadata, 355 N. Ashland, Chicago, IL 60607). The program provides on-screen reminders for spectrometer operation, and plots spectra and calibration curves for immediate feedback. The integrating nature of the A/D conversion noticeably improves the spectrometer signal to noise ratio. 3) We have also recycled some Commodore VIC-20 computers as coulometric titrators, using the built-in timer and digital switching capability to control an external constant current source.

028 MEASURING PRESSURES THROUGH THE APPLE GAME PORT. James P. Birk and David Walters, Department of Chemistry, Arizona State University, Tempe, AZ 85287.

A pressure transducer, SenSym SCX15DNC, mounted on a Sen Sym SCX Universal Amplifier Board, has been used as a pressure sensor for the Apple IIe computer. An additional circuit was designed to convert the 0-16 V output from this board to an output suitable for measurement with the Apple game port. The device is calibrated with a mercury manometer and gives highly reproducible readings. Game port readings can be related to pressure differences by a polynomial curve fitting routine, for which software has been developed. The practical limits of measurement are generally over a pressure range of about 100 torr.

This device has been used to carry out a number of pressure measurements, including the variation of pressure with temperature at fixed volume (Charles Law), vapor pressure determinations, and the amount of water in soils. Experiments using the pressure sensor will be described in detail.

029 INTERFACED FAST LUMINESCENCE DECAY TIME EXPERIMENT AND A GENERAL PURPOSE NONLINEAR LEAST SQUARES DATA FITTING PROGRAM, J. N. Demas, S. W. Snyder, and R. Ballew, University of Virginia, Charlottesville, VA 22901.

An inexpensive computer interfaced fast luminescence decay time experiment is described. This inexpensive system is based on a commercial $25 xenon photostrobe and is used to measure lifetimes <1 ms and bimolecular quenching rate constants of $>10^8$. It is used to demonstrate the important concepts of signal-to-noise enhancement by ensemble averaging, quantization noise errors, and the reduction of quantization noise by ensemble averaging. Also, a general purpose nonlinear least squares data fitting simplex Turbo Pascal program is described. It directly fits a variety of important models, but it is easily altered to accommodate any user model. It supports point and shoot data file loading, integrated graphics, and parameter uncertainty estimation. After each iteration, the current best fit is shown with the data. This is pedagogically useful as it shows the tortuous course of nonlinear fits, and it is also very useful for terminating searches towards false minima and estimating better initial starting parameters. After fitting, the best fits and residual plots can be viewed and saved to disk for plotting by commercial plotting routines.

030 NSF'S PLANS FOR UNDERGRADUATE EDUCATION
ROBERT F. WATSON (National Science Foundation)

NSF in 1989 released two major reports on undergraduate education: one based on workshops representing each of the disciplines of Biology, Chemistry, Computer Science, Engineering, Geoscience, Mathematics, and Physics; another that focused exclusively on U. S. two-year and community colleges. The recommendations of these reports have contributed to a comprehensive NSF-wide approach toward securing the health of undergraduate education in the United States. The plan's major entry points are Laboratory, Curriculum, Faculty, Students, Institutional Development, and Research and Analysis; incorporated within each of these is a high priority concern for under-represented groups. Implementation of this plan is underway and major new initiatives and increases in funding are projected for 1990 and beyond. To serve as the focal point for NSF's undergraduate initiative, the Division of Undergraduate Science, Engineering, and Mathematics Education has been established in the Directorate for Science and Engineering Education.

031 UNDERGRADUATE FACULTY ENHANCEMENT PROGRAM AT NSF. Nina M. Roscher, Division of Undergraduate Science, Engineering and Mathematics Education, National Science Foundation, Washington, DC 20550

The faculty are the key elements in undergraduate education. It is important that they be intellectually vigorous and excited about their disciplines, that their knowledge of recent developments in their fields be up-to-date, and that they regard teaching undergraduates as an important and rewarding activity. To these ends, the NSF provides leadership and financial assistance to encourage colleges and universities to take a systematic interest in the currency and vitality of faculty who are involved in undergraduate teaching and to assist them in enhancing their disciplinary capabilities and teaching skills. The Undergraduate Faculty Enhancement Program makes grants to conduct regional or national seminars, short courses, workshops, or similar activities for groups of faculty members. Grants are made for the development and implementation of ways to assist large numbers of faculty to learn new ideas and techniques in their fields, and to use the knowledge and experience to improve their undergraduate teaching abilities.

032 FACULTY ENHANCEMENT IN THE CHEMICAL SCIENCES AT THE REGIONAL UNIVERSITIES OF MISSISSIPPI. D. L. Wertz, Department of Chemistry and Biochemistry, University of Southern Mississippi, Hattiesburg, Mississippi 39406-5043.

1990 chemistry delivered to the regional universities is the object of a symbiotic project which includes a comprehensive research-oriented University, four widely diverse regional universities, and the administrative staff of the Institutions of Higher Learning, State of Mississippi. Participants in this project are the chemical sciences faculties of the regional universities, each an entity with a distinct student clientele, where the principal activities are confined to lecture and laboratory teaching.

Six one week Chemical Sciences Conferences, each on a different topic of national importance, will be held over a three year period. Each of the conferences will be organized and directed by chair(s) who are research active in that area (i.e., Recombinant DNA Technology). International experts lead the scientific discussions, and extensive hands-on laboratory activities reinforce each learning experience.

Follow-up, to aid the Regional University faculty in incorporating 1990's chemistry into their courses, is planned.

033 FACULTY PROFESSIONAL ENHANCEMENT PROGRAM AT FLORIDA STATE UNIVERSITY. Penny J. Gilmer and Robley J. Light, Department of Chemistry, Florida State University, Tallahassee, FL 32306-3006.

Since 1987 we have offered a Faculty Professional Enhancement Program for 4-6 visiting faculty each summer. We received funding for three years from a private foundation, the Jessie Ball duPont Fund. This grant supported parallel summer programs for faculty and undergraduate students from other institutions. All participants did full-time research, generally for 10-12 weeks. We encouraged faculty applicants to enlist an undergraduate junior from their institution to apply simultaneously for the student program, with the idea that the visiting faculty and the student could work with the same FSU faculty member and continue the research at their home institution upon their return. Faculty stipends were $3300/month. The visiting participants generally come from the southeastern part of the United States. To date, we have hosted 11 visiting faculty with three of them returning formally for a second summer. Visiting faculty have been very enthusiastic about this program. One said in a final questionaire, "This has been valuable to me professionally as a way of maintaining a research involvement while teaching in a largely undergraduate institution."

034 **A REPORT ON THE AUBURN UNDERGRADUATE INORGANIC CHEMISTRY FACULTY ENHANCEMENT WORKSHOP.** David M. Stanbury, Department of Chemistry, Auburn University, Auburn, AL 36849.

A week-long workshop was held at Auburn University during the summer of 1989 under the sponsorship of the NSF Undergraduate Faculty Enhancement Program. This workshop was for inorganic chemistry faculty in the southeast. The 19 participants represented institutions in Alabama, Georgia, Florida, Puerto Rico, Florida, Louisiana, North Carolina, Tennessee, Mississippi, and Kentucky, and included 1 woman, 3 blacks, and 1 hispanic. The participants were placed in groups of four, and each group rotated through a sequence of topics in inorganic chemistry, spending one day per topic. These topics were: synthesis, electrochemistry, X-ray crystallography, FTIR spectroscopy, NMR spectroscopy, and quantum calculations. All the sessions were organized around the chemistry of $[Fe(C_5H_5)(CO)_2]_2$ and its derivatives.

035 **WORKSHOP OPPORTUNITIES IN CHEMISTRY FOR UNDERGRADUATE FACULTY IN SOUTHEASTERN UNITED STATES.** Curtis T. Sears, Jr., Department of Chemistry, Georgia State University, Atlanta, Georgia 30303.

The Departments of Chemistry at Georgia State University and Georgia Institute of Technology with the support of the Division of Undergraduate Science, Engineering and Mathematics Education of the National Science Foundation conduct three week-long workshops and a two-day minicourse annually for the chemistry faculty of two- and four-year colleges in the southeastern U.S. Workshop topics include: chromatography, instrument interfacing, mass spectrometry, molecular modeling, molecular orbital theory and FT-NMR spectroscopy. Workshops consist of approximately 20 hours of lecture and discussion and 25 hours of hands-on experience. Emphasis is on applications of the topics to the undergraduate college setting including student laboratory activities. Minicourses consist of eight hours of classroom instruction in instrumentation in organometallic/catalysis, solid state chemistry/superconductivity and DNA chemistry/biotechnology. Annual reunions of participants allow an exchange of ideas for implementation in the undergraduate curriculum. Detailed descriptions of the workshops will be presented.

036 CHEMISTRY IN CONTEXT: THE CHEMCOM CONCEPT GOES TO COLLEGE. A. Truman Schwartz, Department of Chemistry, Macalester College, St. Paul, Minnesota 55105

The innovative ACS-sponsored high school chemistry text, Chemistry in the Community, has proved so successful that the decision has been made to prepare and publish a college text for nonscience majors based on a similar approach. The name chosen for this book, Chemistry in Context: Applying Chemistry to Society, captures its pedagogical philosophy. The major focus is on socially significant problems such as global warming, water quality, energy generation, and new synthetic materials. The chemistry is introduced as needed to inform the readers' understanding of the technical problems involved. Social, political, economic, legal, and international factors are considered along with the phenomena and methodology of the chemical sciences. This paper will present a status report and an overview of the project. In the papers that follow, other members of the writing team will describe and illustrate specific features of ChemText. Sample drafts of some of the materials already prepared will be available and there will be opportunities for questions and discussion.

037 ACID DEPOSITION AS AN EXAMPLE OF CHEMISTRY IN CONTEXT, William F. Coleman, Department of Chemistry, Wellesley College, Wellesley, MA 02181.

The phenomenon of acid deposition, a more inclusive term than acid rain, is a very appropriate one to include in the type of course for which ChemText is being written. There are certainly important societal issues, ranging from energy policy to environmental protection to international law, associated with this subject. In addition the topic brings together a number of important chemical principles including acid-base chemistry, equilibrium, oxidation-reduction and others. These principles are developed on a need-to-know basis, while at the same time providing sufficient breadth of coverage to enable the student users of the text gain an appreciation for the applicability of the concepts. Much of this paper will focus on the question of searching for an appropriate balance between chemical rigor, as understood in the traditional (perhaps stereotypical) sense and the integration of the chemistry within the broader view of the topic at hand.

038 CHEMISTRY IN CONTEXT: THE WATER UNIT
Conrad Stanitski, Department of Chemistry, Mount Union College, Alliance, OH 44601

Chemistry in Context: Applying Chemistry to Society has eight modules or units designed to teach chemical principles in a context of technological applications to society. A unit on water is one of the four core units with chemical principles incorporated on a "need-to-know" basis, a theme consistent throughout the text. Socio-technological aspects in this unit will include the range and distribution of water and its varied uses, the increasing need for potable water in light of per capita demands, and water pollution and purification. A case study of Onondaga Lake will provide opportunities to discuss water usage, industrial chemical processes, pollution caused by industrial and municipal wastes, and the complex circumstances affiliated with pollution abatement in the lake. Examples of chemical principles and their applications within the unit will be presented.

039 ENERGY IN CHEMTEXT. Arden P. Zipp, Chemistry Department, SUNY - Cortland, Cortland, NY 13045.

Energy is one of four core topics treated in the Chemistry in Context project. This paper will discuss the rationale and level of the presentation of this topic as well as describing some of the special features which have been developed for it.

040 CHEMTEXT: ACTIVITIES TO INVOLVE NON-SCIENCE MAJORS IN CHEMISTRY. Diane M. Bunce, Department of Chemistry, The Catholic University of America, Washington, D.C. 20064

New chemistry textbooks come out almost every year but sadly each one looks very much like the previous one--same topics, examples and exercises. ChemText breaks the mold by presenting the chemistry behind topics that most citizens in a democracy are concerned about.

Selection of such topics is great but not always sufficient to encourage non-science majors to delve into chemistry with as much confidence and vigor as they would in other subjects. So ChemText goes further. We have developed exercises, thought-provoking questions, individual and group activities that help students apply the cognitive skills of their major disciplines to the study of chemistry. These features have titles such as "TRY IT", "WHAT DO YOU THINK?", "FIND OUT", "WHAT IF?", "SCEPTICAL CHYMIST", and "POINT/COUNTERPOINT". They're not your traditional chemistry exercises.

During this presentation, we will present samples of these activities and invite the audience to participate.

041 LABORATORY EXERCISES FOR THE CHEMICALLY PERPLEXED. Robert G. Silberman, Department of Chemistry, SUNY at Cortland, Cortland, NY 13045 and Wilmer J. Stratton, Department of Chemistry, Earlham College, Richmond, IN 47374

The majority of college non-science majors have had puzzling laboratory experiences mostly because the lab exercises had no real meaning in the context of the course. The laboratory exercises for ChemText are designed to show the relationship between experimental science and the concepts developed from experimentation. Many of the exercises are designed to relate directly to real world case studies that are a central feature of the text. We believe that they take an approach that encourages experimentation and careful observation, clarifies concepts and gives meaning to the information in the textbook. Many of the experiments are done on a microscale, and some can be carried out in a classroom rather than a laboratory setting. Some of these experiments will be described, and members of the audience will have an opportunity to try them at their seats.

042 COLLEGE CHEMISTRY FOR BUSINESS STUDENTS USING THE ISSUES APPROACH. David L. Adams, Babson College, Babson Park, MA 02157-0901.

Over the past few years the need for chemistry courses for non-science majors has been recognized. The ACS ChemCom course and the College Chem-Com project demonstrate this recognition. At Babson, a 4-year business college, all undergraduates are business majors and provide an important group in which to develop chemical literacy. The course described here is titled "Chemical Technologies in the Manufacturing System" and revolves around the four issues of materials science, energy, waste management, and the chemical industry. The first three issues comprise the components of the manufacturing system - starting materials are transformed into products through energy use with the generation of "waste". These issues are ppropriate for business students and provide the opportunity to discuss the fundamentals of chemistry.

The presentation will discuss the course outline, innovative pedagogical devices such as case studies in each unit, mini-research projects, and student final projects; and ideas for future course changes.

043

SCIENCE OF FOOD: A NEW CHEMISTRY COURSE AT UNIVERSITY OF NEBRASKA. James D. Carr, John H. Rupnow & Nancy M. Betts, Dept. of Chemistry, U. of Nebraska, Lincoln, NE 68588-0304

A new interdisciplinary course, Science of Food, is being taught at University of Nebraska. The course is team taught by members of the departments of Chemistry, Food Science & Technology, and Human Nutrition. The course is approved as a science elective and as a General Liberal Education course in the science area. A lot of chemistry is presented in the context of structure and behavior of molecules in our foods. Covalent bonding in fats, carbohydrates and proteins are emphasized and the behavior of these substances upon processing and digestion continue the molecular emphasis in the course. Food additives, preservation techniques, and processing are emphasized. Outcomes of the course as well as an overview of the contents will be emphasized in this presentation.

044 TEACHING NON-SCIENCE MAJORS TO BE MORE THAN SCIENCE COUCH POTATOES. *Sylvia J. Berens, Ph.D.*, United States International University, San Diego, CA 92131

Most traditional science courses designed for the non-science major attempt to simply present a wide variety of facts and formulas, to students expecting only the regurgitation of the same on exams. In most cases there is very little to excite, involve, motivate, or make relevant to the student any of the material we expect them to learn. Many liberal arts students dread science courses. We feel that by treating students as science couch potatoes and not involving or making relevant the scientific facts we present is what is responsible for much of the lack of interest of the non science major. We have developed a course where we do not allow the students to remain couch potatoes but immerse them in the scientific process and experience by augmenting the more traditional presentation by labs that bring everyday relevance, group activities that involve students in the scientific process, field trips to see first hand the importance of what we teach, and student research into topics of interest to them. By avoiding the couch potato syndrome, we feel that we can motivate students to want to learn more about science and in many cases are able to foster a life long interest and more clear understanding of the science and technology that surrounds them in their everyday lives.

045 DEVELOPMENT OF LABORATORIES IN CHEMISTRY FOR THE NON-SCIENCE MAJOR. Zvi Szafran Mono M. Singh, Angelicki A. Rigos, Carolyn A. Werman, Stephen A. Leone, J.David Davis and Ronald M. Pike, Department of Chemistry, Merrimack College, North Andover, MA 01845.

There is an increasing public awareness of the need to expose non-science majors to the scientific method. Many colleges and universities offer lecture courses to fulfill liberal arts distribution requirements. Few, however, offer a laboratory component an integral part of these courses.

We, at Merrimack College, have developed a 3-credit chemistry course directed toward the non-science major. It consists of two one-hour lecture and one 90-minute laboratory sessions per week. The laboratory component has been designed to expose the student to the essential techniques and theory associated with the scientific method in general, and chemistry in particular.

The problems encountered in introducing this type of course will be presented. The laboratory content and the initial impact on the students will also be covered.

046 BIOCHEMISTRY OPTIONS AT A COMMUNITY COLLEGE. Mary C. Fields, Collin County Community College, 2800 E. Spring Creek Pkwy., Plano, TX 75074

Collin County Community College proposed and received local and state approval for the addition of Chemistry 193: Biochemistry Seminar to the chemistry curriculum and regular course schedule. Spring 1990 serves as a landmark at CCCC as it is the term in which the first biochemistry seminar was held. The focus of the presentation will included: (1) the proposal presented to the Coordinating Board: (2) the student prerequisites and course enrollment process; (3) the course content and teaching/learning format and (4) the student and faculty participation in this seminar. Discussion regarding curriculum options at other community colleges will be encouraged.

047 APPLICATION OF MYERS-BRIGGS TYPE INDICATOR TO CHEMICAL EDUCATION: A STUDY OF THE ROLE OF PERSONALITY TYPE IN SOLVING CHEMISTRY PROBLEMS. Richard J. Wyma, Department of Chemistry, Indiana-Purdue University at Indianapolis, Indianapolis, IN 46205. J. Dudley Herron and Norbert Muller, Department of Chemistry, Purdue University, West Lafayette, IN 47907.

The Myers-Briggs Type Indicator is a personality assessment instrument which is commonly used by psychologists and counselors. The Indicator is a compilation of items which help to identify personality preferences of individuals. Two preference areas which impact heavily on chemical problem solving are: perceiving or gathering facts by "sensing" or " intuition" and judging or making decisions by "thinking" or "feeling." The frequency distribution of personality types in a typical undergraduate physical chemistry course at Purdue University is 41.8% ST, 16.4% SF, 11.9% NF and 29.8% NT. A study of total course scores and math SAT scores shows a close correlation for ST and SF types but not for NT and NF types. Reasons for these differences will be discussed. Examination questions which stress factual and conceptual content will be discussed and student performance will be correlated with personality types. Our studies have shown that personality preferences affect the way students solve problems, but the relationships are complex. Case studies from student interviews will be used to interpret the data.

048 EFFECT OF INFORMATION FORMAT ON STUDENTS' PROBLEM SOLVING STRATEGIES. A. W. Friedel, Department of Chemistry, D. P. Maloney, Department of Physics, Indiana-Purdue at Fort Wayne, Fort Wayne, IN 46805

This paper describes an investigation of college general chemistry students' procedures for working problems involving multi-atom molecular substances. The problems involved four pieces of information: actual mass present, molar mass, number of atoms per molecule and the total number of atoms. The problems required the students to determine either the number of atoms present or the mass of substance present. Three formats--verbal, diagram and formula--were used for presenting the information about the number of atoms per molecule for each substance. Analysis of students' responses indicated that they were employing different strategies depending on the format. The verbal format was worked correctly most often and the formula format was worked correctly least often. Hypotheses to explain the different results will be presented as well as some ideas for instructional approaches to correct the deficient strategies.

049 WHAT ARE GOOD PREDICTORS OF FRESHMAN CHEMISTRY SCORES? Nancy J. S. Peters and Kristen A. Hallock, Natural Science Division, Long Island University/Southampton Campus, Southampton, New York 11968.

Various test scores and high school grades, as well as students' own predictions, are correlated with first semester chemistry grades. Students at Southampton are placed in regular or honors Freshman Chemistry after review of several, but not all, of the factors considered here. It is our hope that a single factor, or combination of a few, will provide adequate guidance for placement.

050 PREDICITION OF ULTIMATE STUDENT PERFORMANCE IN GENERAL CHEMISTRY FROM FIRST EXAM SCORES. Marcy L. Hamby and William R. Robinson, Department of Chemistry, Purdue University, West Lafayette, Indiana 47907.

Students at Purdue University register for spring courses during the middle of the fall semester. Consequently a student and his/her advisor do not know whether or not the student will be successful in completing the first semester of the general chemistry sequence. (Student self reports are not useful because students are overly optimistic about their chances for success.) We have undertaked a study that will let us provide information to advisors during the fall semester concerning those students who should be counselled to "wait and see how you do" before scheduling second semester chemistry courses. The reliability of the predictors will be discussed.

051 ABSTRACT ADVENTURES IN COMPUTER TESTING. John Kenkel, Southeast Community College, 8800 "O" Street, Lincoln, Nebraska 68520.

Multiple choice exercises that can be used for tests, quizzes, or homework have been developed for the Apple II computers using different question and answer selection methods. They are summarized as follows: 1) Random question generation/random answer choices; 2) Non-random question generation/random answer choices; 3) Random question generation/non-random answer choices; and 4) Non-random question generation/non-random answer choices.

Each will be discussed according to their usefulness and application.

Two different methods of grade reporting have been used. In each case, the computer tallies the student's grade by keeping track of the number answered correctly. The grade is either (1) stored in a file on the disk or (2) printed on a printer.

The advantages to the instructor are (1) the time required for developing and grading a test or homework is greatly reduced and (2) the multiple choice format eliminates errors in answer entry, since only a number or letter is entered. The advantages to the student are (1) if the instructor required these exercises as homework or pre-exam study material, there would be increased (forced?) exposure to the subject matter and problem solving and (2) there is increased exposure to computers.

052 CONSTRUCTION AND ANALYSIS OF MULTIPLE CHOICE TESTS. C.A. Baker, Department of Chemistry, Butler University, Indianapolis, Indiana 46208.

Each year the Indiana Section of ACS conducts a scholarship examination for high school students. The examination is a 100 item multiple choice test that is taken by both first and second year students. The results of the test must discriminate among the most capable of students. In order to improve the quality of the test, we have subjected the tests for the last two years to item analysis using a Scantron interfaced with an IBM compatible computer. The analysis software is typical of that available, at reasonable cost, to owners of the hardware.

The purpose of the presentation is to assist teachers in using item analysis and statistics to improve their own tests. During the presentation we will look at the computer printout of the overall item analysis and a subset of test questions. We will review the statistical concepts needed to use the item analysis in assessing the quality of the test as a whole and that of individual test items. We will also look at sample questions, their statistics, and discuss the features of each item that made it a good or bad item.

053 NEAR INFRAREDSPECTROSCOPY AND THE NEW ANALYTICAL PARADIGM.
James B. Callis, Center for Process Analytical Chemistry, University of Washington, Seattle, WA 98195.

Traditional approaches to analysis involve the time consuming steps of sample acquisition, clean-up and purification before the final instrumental measurement. Moreover, such a process takes place in the sheltered confines of the laboratory which is frequently remote from the sample site. Now, technological developments in the fields of electrooptics are being combined with new computer hardware and sophisticated data-reduction methodology to yield analytical instruments which are capable of making in-field and at-line measurements. Moreover, such measurements can be made non-destructively on a wide variety of specimens and multiple attributes are acquired simultaneously. One instrument which typifies this "new" analytical chemistry is the Lap-Top NIR Spectrometer. At first sight, the NIR spectrum from 700-1000nm would appear poorly suited as the basis of a new analytical technique. After all, the absorption coefficients are extremely weak and the peaks are broad and overlap severely in this region of the vibrational overtone spectrum. Nevertheless, with modern instrumentation which achieves 10^4-10^5 signal to noise ratios and multivariate calibration methodology is it frequently possible to make remote, nondestructive measurements in the field. Examples of the usefulness of the technology in gasoline analysis where octane number, density, Bromine number and total aromatics, aliphatics and olefenics are measured simultaneously will be given. Additionally, the possibility of monitoring a fermentation process non-invasively will be illustrated. Here, ethanol concentration, cell density and oxygen status are measured from outside the vessel.

054 INFRARED SPECTROMETRY OF NON-TRADITIONAL SAMPLES. James A. de Haseth, Department of Chemistry, University of Georgia, Athens, GA 30602.

Infrared spectrometry is becoming more important in the investigation of samples that are difficult, or impossible, to measure using standard spectrometric methods. For example, it is possible to measure infrared spectra of opaque samples, not only at the surface, but in the interior. If an infrared transmitting fiber can be imbedded in the sample, spectra can be acquired from the interior of the sample. This is accomplished through attenuated total reflectance. Examples of samples that can be analyzed in this manner are thermoset polymer laminates or solid polymers, such as polyurethanes. Not only can qualitative information be gained from these studies, but reaction mechanisms and kinetics can be measured as well. Another area where infrared spectrometry is extremely useful is the identification of chromatographed components of complex mixtures. Whereas gas chromatography has been interfaced successfully to FT-IR spectrometry for some years, liquid chromatography can now be interfaced. Infrared spectra of the components serves to identify the exact chemical structure. These analyses can be carried out with normal or reverse-phase chromatography.

055 THE UTILIZATION OF FAR INFRARED SPECTROSCOPY FOR THE DETERMINATION OF CONFORMATIONAL STABILITIES AND BARRIERS TO INTERNAL ROTATION. J. R. Durig, Department of Chemistry, University of South Carolina, Columbia, South Carolina 29208.

Surprisingly, the first chemical applications of FT-IR spectroscopy were made in the far infrared region of the spectrum, which may be loosely defined as the region from 200 to 10 cm^{-1}, since the interferometric instrumentation required to study this spectral region was much simpler than that needed for the mid- or near infrared regions. Low frequency FT-IR spectroscopy is among the most generally applicable methods used in the study of the conformations of certain types of small molecules with few substituents. Infrared spectra can be recorded in all phases, and variable temperature experiments may be conducted in all phases as well. Additionally, gas phase band contours observed for the infrared spectra, along with Raman depolarization data, provide considerable information on the molecular symmetry of the conformers. Thus, vibrational spectroscopy has been successfully used to determine the conformational stabilities and equilibria in a number of chemically important systems. Spectroscopic results for symmetric and asymmetric torsional vibrations and small ring inversions will be presented.

056 SPECTROSCOPY WITH FT-IR MICROSCOPES. D. W. Schiering, The Perkin-Elmer Corporation, 761 Main Ave., Norwalk, CT 06859-0240

The reflecting microscope has revolutionized infrared (IR) microspectroscopy and stimulated tremendous growth in analytical IR microanalysis of condensed phase samples. The idea of coupling microscopes to IR spectrometers is not new, having been first reported in the late 1940's. The development of relatively low cost FT-IR spectrometers with sensitive detectors was required for the microscope technique to become viable, however. This discussion will focus on an overview of the technology and selected applications of FT-IR microspectroscopy. The general design of modern FT-IR microscopes will be compared to the first commercial IR microscope, introduced in the early 1950's. Applications of the technique from diverse areas such as biological science, materials science, art history, criminalistics, and electronics quality assuarance will be presented.

057 SPECTROSCOPIC STUDIES OF AQUEOUS Al(III)/ACETATE SOLUTIONS, K. R. Williams, W. S. Brey, J. L. Bradley, A. G. Fosmoe II, R. Jimenez, J. West, and R. Lanier, Department of Chemistry, University of Florida, Gainesville, FL 32611-2046.

The interactions of acetate and Al(III) ions in aqueous solution have been investigated by FT-IR and Raman, and by ^{1}H, ^{13}C and ^{27}Al NMR. At least two different forms of complexed acetate are observed in solutions with total Al(III) concentrations of 0.3 and 0.4 M and with total acetate to total aluminum ratios, R, as low as 0.2. The absorptions in the C-O and C-C stretching regions change dramatically as a function of R, and the ^{1}H and ^{13}C chemical shifts are also affected. The ^{13}C NMR peak for bulk acetate exhibits a downfield shift as the solution pH increases. The magnitude of the shift is greater than that for acetate buffer solutions, an indication that there is at least one form of acetate which, on the NMR time scale, is rapidly equilibrating with the bulk acetate. An additional absorption attributable to this loosely bound form is observed in the symmetric C-O stretching region of the Raman and IR spectra. An indication of the possible modes of coordination of the acetate may be obtained from previously reported correlations of IR frequency data to known structures.

058 REFLECTANCE FT-IR MICROSPECTROSCOPY: THE KRAMERS-KRONIG TRANSFORM AND ITS APPLICATION. D. W. Schiering, The Perkin-Elmer Corporation, 761 Main Ave., Norwalk, CT 06859-0240

The reflectance infrared (IR) spectrum is invaluable data for the determination of other fundamental properties of a solid material. By consideration of the normal incidence reflectivity, relations may be developed for the determination of the refractive index and extinction coefficient. A Kramers-Kronig (KK) integral transform is generally utilized to determine the frequency dependent phase change on reflection. Most commercial FT-IR microscopes can be used in a reflectance spectroscopy mode of operation. Through the microscope KK transform and its application in the computation of absorption spectra has therefore been brought into the realm of the analytical chemical spectroscopist. This discussion will focus on the implementation of the KK transform for spectra measured with an FT-IR microscope. Areas of concern include diffuse reflection contribution, oblique incidence, and phase contribution from outside the spectral range of interest.

059 MICROSCOPE OPTIMIZATION FOR FT-IR MICROSPECTROSCOPY. D.W.Schiering, E.F. Young, The Perkin-Elmer Corporation, 761 Main Ave., Norwalk, CT 06859-0240

A previous discussion focussed on an overview of the technology and applications of FT-IR microspectroscopy. This presentation will concern the optimization of a specific microscope design for FT-IR microspectroscopy. The FT-IR microscope is a hybrid technology. Two systems--optical microscopy and FT-IR microspectroscopy--serving different functions must mesh and satisfy their own particular requirements. Requirements for optical microscopy include images which are free from aberrations, a range of magnifications, photomicrography capability, and versatility in specimen manipulation. For efficient IR energy transfer there is a requirement to minimize the number of transfer optics, especially focussing optics from the standpoint of the associated reflective losses, alignment errors, and optical aberrations. The design of the Cassegrain system will be considered in relation to the optical microscopy and FT-IR microspectroscopy requirements.

060 ENVIRONMENTAL ISSUES IN THE CHEMISTRY CURRICULUM. Victor J. Mayer, Science Education, The Ohio State University, 1945 N. High St. Columbus, OH 43210

There have been a series of national and international reports documenting the problems in science education. Some of the most devastating information regarding the level of public knowledge of science is in the areas of earth and environmental sciences. The 1986 NAEP report, for example, pointed out that the only areas of achievement decline among high school students that remained statistically significant was in the earth and environmental sciences. Yet very little attention is being paid to these problems. A conference of Educators and Geoscientists held in Washington in 1988 agreed on four goals and ten concepts that every citizen should understand about Planet Earth. The report of this conference has implications for the teaching of chemistry, as it does for all school science. Chemistry teachers must address issues of environmental quality and the ways the technology impacts upon the earth systems through the manufacture and use of chemicals. Programs such as ChemCom and an NSF supported project entitles "Secondary School Modules for Education in Global Change" can assist the chemistry teacher in providing a stimulating and modern treatment of the subject for all students.

061 HOW CONFLICTING ANALYSES OF GLOBAL CHANGE SHAPE PUBLIC PERCEPTIONS AND TEACHING STRATEGIES. Will Hon. University of Georgia Marine Extension Service, Savannah, Georgia 31416

The dynamic of coastal waters is so complex that when dramatic events occur the level of predictability of physical, chemical and biological changes is very low. Even in hindsight the major estuarine crises have so many variables that transference of data and response techniques are not only ineffective but misleading. At the global level change is even less explainable, yet journalists now seem unanimously locked in on some apparent crises such as greenhouse effect and compromise of the ozone shield. Teachers must wrestle not only with evaluation of scientific studies, but with conflicting perceptions of the threats posed and the political actions needed. Educators are doing a mediocre job of teaching students the answers to our current questions but the greater threat is that we're doing much worse at teaching them to frame pertinent, penetrating questions which are the essence of inquiry.

062 ENVIRONMENTAL ISSUES ON A GLOBAL SCALE A TEACHER'S PERSPECTIVE. Dan Jax, Bexley City Schools, 348 S. Cassingham Ave., Bexley, OH 43209

In a time of increasing concern for the environment on a global scale, it is imperative that global change topics be included in the science curriculum as much as possible. A survey of sources of existing global change activities and current development projects for activities concerning global change will be presented. The availability of information on nationally accessible data bases and from other sources will be considered. How such activities and information might be integrated into an existing curriculum and the dislocations produced as a result will be discussed.

063 IMPROVING THE PUBLIC IMAGE OF CHEMISTRY. E. J. Pulliam, Moderator, Dept. of Chemistry, Florida State University, Tallahassee, FL 32306-3006

Plenary speakers Mark Wrighton, Walter McCrone, Bassam Shakhashiri, and Marjorie Gardner will form a panel to discuss the current perceptions of chemistry by the public. The panel will also address ways in which we can improve the image of chemists and chemistry on the national level.

064 DISCOVERY AND DEVELOPMENT OF THERAPIES TO TREAT AIDS AND ITS SEQUELA; Margaret I. Johnston, Nava Sarver, Mohamed Nasr, Charles Litterst; 6003 Executive Blvd. 245P Rockville, Maryland 20852

Discovery of potential therapies to treat infection by the human immunodeficiency virus (HIV) and the opportunistic infections (OIs) associated with AIDS includes both large scale screening and targeted approches. Increased basic research efforts on the mechanism of HIV replication and the characterization of HIV targets has led to the development of biochemical assays for inhibitors of HIV replication. These efforts have fostered the discovery of new agents that show potential in inhibiting HIV entry, HIV reverse transcription, activation of HIV transcription and processing of viral proteins. Similar approaches are underway to discover new potential therapies to treat OIs. Animal models have proven useful in evaluating potential anti-HIV and anit-OI therapies and combinations of therapies as well as immunomodulators. Promising approaches, new drugs, and novel approaches such as ribozymes will be overviewed.

065 ANTI-HIV ACTIVITY OF 3'-AZIDO-3'-DEOXYTHYMIDINE AND RELATED COMPOUNDS. J. L. Rideout, Division of Organic Chemistry, Burroughs Wellcome Co., Research Triangle Park, North Carolina 27709

This presentation will show the development of 3'-azido-3'-deoxythymidine (Retrovir, AZT, zidovudine) at Burroughs Wellcome Co. from the initial assessment of it as an antibacterial agent to the subsequent recognition of its activity against retroviruses. The synthesis of AZT will be described and the search (by many investigators) for active analogues will be indicated in SAR discussions. Physical properties, mechanism of action, and metabolism will be addressed. Some indication of current efforts to discover new compounds for the treatment of AIDS will be included.

066 HIV PROTEASE AS A THERAPEUTIC TARGET. Garland R. Marshall, Center for Molecular Design, Washington University, St. Louis, Missouri 63110.

The protease encoded by the viral genome of human immunodeficiency virus (HIV) is a logical target for therapeutic intervention, as it is responsible for the maturation of several enzymes essential for viral replication. Based on the concept of transition-state inhibitors, analogs of peptide substrates of HIV protease have been prepared with sub-nanomolar affinities for HIV protease. The crystal structures of two different classes of these inhibitors complexed with synthetic HIV protease have been determined and serve as templates for the development of second generation, peptidomimetic inhibitors. HIV protease inhibitors have been shown to inhibit maturation of viral enzymes in infected cells in culture and to inhibit viral infectivity. Problems associated with the conversion of these lead compounds into drugs will be discussed.

(Supported in part by grants from the NIH, AI-27302 and GM-24483, and from Monsanto, 44353K).

067 THE DESIGN OF NEW THERAPEUTIC AGENTS AGAINST THE HUMAN IMMUNODEFICIENCY VIRUS. Dabney W. Dixon, Ph.D., Department of Chemistry, Georgia State University, Atlanta GA 30303.

Acquired autoimmune deficiency syndrome (AIDS) is taking a large and increasing medical, social and financial toll. This talk will discuss the design of new therapeutic agents against the human immunodeficiency virus. Possible targets will be outlined. A new class of anti-AIDS compounds, the porphyrins, will be discussed. We have preliminary evidence that diverse types of porphyrins and metalloporphyrins are active against the HIV virus in peripheral blood mononuclear (PBM) cells in vitro. Both "natural" porphyrins (i.e. those derived ultimately from protoporphyrin IX, the porphyrin found in hemoglobin) and the "synthetic" porphyrins (i.e. symmetrical porphyrins made in the laboratory from pyrrole and aldehydes) are active, many in the 0.1 to 10 μM range. The biological and clinical roles of porphyrins will be examined. Some porphyrins appear to be reverse transcriptase inhibitors; the design and synthesis of reverse transcriptase inhibitors will be emphasized.

068 ENVIRONMENTAL CHEMISTRY-DREYFUS/WOODROW WILSON FOUNDATION. Linda M. Stroud, Broughton High School, Raleigh, NC 27605. DeWayne L. Lieneman, Glenbard High School, Glen Ellyn, IL 60137. Richard Willis, Kennebunk High School, Kennebunk, ME 04043. Denise L. Creech, Hilton Head High School, Hilton Head, SC 29928.

The Camille and Henry Dreyfus Foundation and the Woodrow Wilson National Fellowship Foundation have sponsored summer workshops for secondary chemistry teachers since 1983. The focus of the 1989 workshop was Environmental Chemistry. Materials and activities developed in the workshop were designed to model methods of using chemistry to increase student awareness of environmental topics. Lectures, demonstrations and experiments (including small-scale applications) were developed in the following areas of environmental concerns: acid rain, ozone depletion, greenhouse effect, and water quality. Integration of these environmental topics into the general chemistry concepts taught in a first year chemistry course will be emphasized in this session. These materials are also applicable to other science courses in the high school curriculum.

069 PLASTICS in the ENVIRONMENT: AN INDUSTRIAL PERSPECTIVE.
Mobil Chemical Company.
Jim Brown, Law Environmental, 112 Town Park, Kennesaw, GA.

The nation's solid waste disposal problem is a growing public concern. Misinformation about the amount of plastic in the solid waste stream, unrealistic expectations about the speed of the degradation process, and the belief that plastic cannot be recycled or safely incinerated sets the stage for making plastic the villain in the solid waste disposal problem. Representatives from Mobil Chemical Company will share their current position on solving the waste problem by 1)source reduction, 2) recycling, 3) incineration, and 4) limited landfilling. Jim Brown from Law Environmental will discuss the plans for resuing polystyrene by the National Polystyrene Recycling Company. The first commercial-size polystyrene recycling plant is located in Leominster, MA, and there are plans to open five other plants by the end of the year. Questions and discussion will folow the presentation. Written materials will be available.

070 ***HyperCard Chemistry Stacks***, D. W. Brooks, Center for Science, Mathematics, and Computer Education, University of Nebraska-Lincoln, Lincoln, Nebraska 68588-0355.

HyperCard® was released by Apple Computer for Macintosh computers in August, 1987. This program represents a new sort of application, one in which a relatively small amount of text, graphic, and sound resources can be managed and accessed quickly and easily. *HyperCard* 'stacks,' the files used by the *HyperCard* application program, are easy to create and manage. They are based on the concept of event-driven, object oriented programming. This presentation will use a variety of stacks, especially *DoChem, MicroScale, ReDox, ClassManager*, and *LessonPlan*.

071 ***Using HyperCard to Control Animated Graphics***, John I. Gelder, Department of Chemistry, Oklahoma State University, Stillwater, Oklahoma 74078

HyperCard® has been selected to be used as the controlling software for delivery of a variety of color graphics, color animation, and videodisc based materials in an advanced placement chemistry course broadcasted by satellite to rural high schools in the United States. Computer based simulations/demonstrations and computer controlled video represents an integral component of the curriculum. Computer graphics is used to provide students with a dynamic view of the atomic level of matter. Seeing representations of matter at the atomic level is critical at the introductory level because students have not had sufficient experience at creating mental images of chemical phenomena from verbal descriptions. Animated computer graphics is an efficient method of transferring crucial information visually. Integrating such materials into HyperCard can provide flexible organization for presentation to students. Several examples of materials developed at Oklahoma State University will be shown to demonstrate HyperCard's strength and flexibility.

072 ***HyperMedia in Undergraduate Organic Laboratory Instruction***, Paul F. Schatz, Department of Chemistry, University of Wisconsin-Madison, Madison, Wisconsin 53706

This paper will describe some of the HyperCard stacks whaich are being used in the undergraduate organic chemistry laboratories at the University of Wisconsin. Besides describing several specific examples of HyperCard stacks, there may be some minor digressions into other hypermedia systems available for the Macintosh and for the MS-DOS world(s).

073 ***Event-Driven, Object-Oriented Programming in HyperTalk***, D. W. Brooks, Center for Science, Mathematics, and Computer Education, University of Nebraska-Lincoln, Lincoln, Nebraska 68588-0355.

Macintosh computers keep track of events -- the mouse button goes up; the cursor enters a particular active space on the screen, the return key is pressed, etc. When the events take place, the computer generates messages. These messages are passed up through a hierarchy of 'objects,' modular constructs of a computer file. The popular program *HyperCard*™ restricts the kinds of objects that are available. Buttons are 'action' objects; fields hold text and may be treated like action objects; buttons and fields reside on cards; and so forth. Stacks of cards may have one or more backgrounds. This talk is intended to introduce the simplest programming concepts used in *HyperCard*, and to try to explain how the programmed effects presented in earlier talks were accomplished. Because the programming 'scripts' are attached to objects rather than to a single program, the stacks can be assembled one piece at a time. Wholesale copying of programming strategies and even scripts is possible.

074 DEDUCING CHEMISTRY AND ELECTRONIC PROPERTIES PICTORIALLY ON THE BLACKBOARD WITH THE VIF: A NEW CHEMIST'S TOOL. Oktay Sinanoglu,

Chemists can now predict the qualitative stabilities, quantum electronic properties, reactivities, and possible reactions of molecules directly from rough pictures (e.g. tentative structural formulas) on the blackboard. No orbitals, no computations. Organic, inorganic, metallo-organic compounds, and cluster are treated individually or in classes. The new framework theory deals not with symmetry, but beyond, with the transformations of molecules into each other, the math having been translated into simple pictorial rules. The approach gives a new way to teach chemistry and makes it fun for students at the secondary school or beginning college levels.

075 AN INTERMEDIATE COURSE IN MOLECULAR SPECTROSCOPY AND QUANTUM CHEMISTRY, C. Weldon Mathews, Department of Chemistry, The Ohio State University, 120 West 18th Avenue, Columbus, Ohio 43210.

A few years ago we introduced a new course designed to help bridge the gap between an undergraduate course in Physical Chemistry and a graduate course in Quantum Chemistry. It is designed for students who may not proceed through a year-long course in Quantum Chemistry, but who do need a more extensive development of quantum chemistry as applied to practical molecular spectroscopy. It also provides supplemental preparation for students who are apprehensive about taking part in the more rigorous and extended discussions of the year-long course. The ten-week course summarizes the fundamental models of quantum chemistry (eg one-electron atoms, harmonic oscillator, and rigid rotor) with an emphasis on the symmetry properties of the associated wavefunctions. The second part of the course applies these results to typical spectra observed for atomic and diatomic systems.

076 APPLICATION PROBLEMS IN PHYSICAL CHEMISTRY. David. M. Whisnant, Department of Chemistry, Wofford College, Spartanburg, SC 20301.

Physical chemistry students often have difficulty seeing what it is good for; they find themselves pitched into a sea of mathematical equations out of sight of any land of physical reality. During the last year I have attempted to help this by devoting the lecture period before each examination to in-class application problems, which the students tackle in groups. These problems, which usually are taken from the recent literature, have a number of advantages. They have many parts and can ask students to use not only material for the next examination but also anything covered in the course up to that point. In addition to the usual calculations, they often require decisions -- in one part the students may have to decide what measurement needs to be made or what tabulated material is needed before the next part is furnished. Examples of these problems are the interaction of leghuminous hemoglobin with nitrogen, the thermochemical properties of ionic-clusters, the decomposition of copper(II) sulfate, the $O(^3P) + PH_3$ reaction and its implications for planetary atmospheres, and non-Kekulè isomers of benzene. The advantages of these problems will be discussed along with the use of spreadsheets and equation solvers which make them possible.

077

COMPARATIVE PERFORMANCE OF LOCALLY PRODUCED VS. COMMERCIAL EQUIPMENT

Ram S. Lamba & Ramón A. De La Cuétara, Inter American University of Puerto Rico, P.O. Box 1293, Hato Rey, PR 00919

The results of utilizing locally produced low cost pH meters and conductometers in teaching laboratory experiments compare favorably with the results obtained performing the same experiments utilizing commercially produced equipment costing ten times as much. A low cost combination pH meter / milivoltmeter with digital display, 0.01 pH unit and 0.1 milivolt resolution and low cost conductometer with 12 ranges from 1 microSiemens to 5 miliSiemens and digital display, each equipped with a low cost computer interface and costing under US$100 were utilized for the comparison. The low cost equipment was utilized in the experiments as "stand-alone" units , and interfaced to a personal computer.

078

LOW COST DEVICES FOR OVERHEAD PROJECTOR DEMONSTRATIONS

by Sally Solomon
Drexel University, Chemistry Department
32nd and Chestnut St
Philadelphia, PA 19104

The overhead projector is readily converted into a variety of different instruments that project measured quantities during the presentation of chemistry lectures. With the investment of very little money the ordinary overhead projector becomes a voltmeter, a pH measuring device, a timer, a source of polarized light, or a spectrometer created from diffraction grating paper and a simple cardboard housing. These and other projecting devices are all designed for use on a horizontal stage thus requiring no specialized projecting equipment and permitting calculations or equations to be written on blank transparencies. Each device can be stored conveniently and used with a minimum of advance preparation. Lecture demonstrations that lend themselves to projection are performed. Also given are ways in which to adjust each demonstration to fit topics presented at different levels of chemistry instruction.

079 HIGH EDUCATIONAL YIELDS FROM USING LOW COST EQUIPMENT, Alice J. Cunningham, Department of Chemistry, Agnes Scott College, Decatur, GA 30030.

An increasing number of secondary school teachers are beginning to appreciate the fact that very fundamental concepts of chemistry can be taught quite adequately with reliable low-cost equipment, some of which can be fabricated very easily. The real educational value in using relatively simple instrumental methods lies in the students' experience with a purposeful, well-organized laboratory procedure and the scientific conclusions to be drawn from the experimental results. Inexpensive equipment for spectral, thermal and electrochemical measurements will be discussed. Primary emphasis of this presentation will be on the importance of obtaining quantitative results and analyzing data in a manner which elucidates more clearly fundamental concept(s) of interest.

080 **SIMPLE DEMONSTRATIONS AND EXPERIMENTS UTILIZING HOUSEHOLD MATERIALS.** Toby F. Block, School of Chemistry and Biochemistry, Georgia Institute of Technology Atlanta, Georgia 30332-0400

The difficulty and cost of obtaining, storing, and properly disposing of chemicals, coupled with the need to purchase or build specialized equipment, are a major deterrent to the use of demonstrations, and even laboratory experiments, at many schools. This paper deals with demonstrations and experiments which employ household materials, such as baking soda, vinegar, rubbing alcohol, rock salt, candles, and balloons. These materials are readily available at low cost, may be purchased in the small quantities needed, and do not require any special care in disposal. The demonstrations and experiments to be discussed will deal with such areas as gas laws, acid/base chemistry, limiting reagent problems, determination of molecular mass, and solution chemistry.

081 TEACHING ENVIRONMENTAL CHEMISTRY THROUGH EXPERIMENTS. Krishna V. Sane, Department of Chemistry, University of Delhi, Delhi 11007, India.

A course of twenty experiments has been standardized for teaching environmental chemistry. The experiments include analysis of water (sea and fresh water) and soil. The analysis is based on estimations (e.g. nitrite, phosphate, silicon, organic carbon, etc.) and on determination of pH and salinity. A notable feature of this course is that the equipment needed for the experiments i.e. a colorimeter, a pH meter and a conductance meter can be self assembled by the student. The various accessories like electrodes, conductance, magnetic stirrer, etc. can be similarly made by the student using readily available materials and components. The course is being tested in student laboratories for feedback.

082 STUDENTS SCIENCE AUTOBIOGRAPHIES: TELLING TALES OF SCIENCE TURNOFFS. Patricia A. Metz, Department of Chemistry, Texas Tech. University, Lubbock, TX 97409 and Nancy W. Brickhouse, Department of Educational Development, University of Delaware, Newark, DE 19716.

Educators, scientists, politicians, and business leaders have all expressed their concerns with the impending shortage of scientists by the year 2000. Furthermore, they have suggested numerous reasons as to why fewer students are pursuing careers in science. We, too, share their concern for this current educational crisis, but question some of the reasons they give. To find out why students are opting out of the sciences and chemistry in particular, we asked students to write their science autobiographies. The stories the students told of their encounters with science suggest somewhat different reasons as to why they are turning away from the sciences.

083 THE PROMISE OF MIDDLE SCIENCE. Patricia L. Samuel, Department of Chemistry, Boston University, 590 Commonwealth Ave., Boston, MA 02215

It is clear that our children must have science teachers who are empowered to prepare them for citizenship in a technologically-oriented society. The middle school years, grades five through nine, are a time when children's inate curiosity about the world and how it works can be cultivated or extinguished. Excellent science teachers are crucial if the former is to happen. Both colleges and universities and local school systems share responsibility for providing such teachers and nurturing them. College faculty in the sciences and in education must work together to design curricula that will provide aspiring middle school science teachers with, preferably, a major in the science and appropriate professional courses. Attention should be paid to the interdisciplinary nature of science as it is taught in middle school. Preservice middle school science teachers need practice in thinking about science as an integrated whole, yet very few science courses for majors that bridge the traditional disciplines exist. Moreover, science faculty bear a special responsibility for encouraging good students to consider teaching as a career. Schools and their supporting communities must provide both adequate salaries and an environment conducive to good teaching and learning, one that gives teachers the freedom to do what they have been trained to do.

084 RE-ENTRY AND REVERSE TRANSFER STUDENTS: SHIFTING THE EQUILIBRIUM. T. Y. Susskind, Department of Science/Health Education, Oakland Community College, Auburn Hills, Michigan 48057

Students entrolled in two-year college chemistry programs differ from the freshman/sophomore population in four-year schools. In particular, the majority of community college students are older than the traditional college age of 18-21. On any given day at 10 a.m. the average age in a community college classroom is 23 years; at 8 p.m. it is 38 years! The majority of our students are part-time, and over 80% are employed while they attend college. Among these are many re-entry students; women preparing to become part of the work force, as well as men and women who are in the process of shifting careers. These re-entry and reverse transfer students present opportunities for recruitment to the chemistry profession.

085 CHEMISTRY MAJORS FROM FIRST YEAR STUDENTS. Stephen J. Hawkes, Department of Chemistry, Oregon State University, Corvallis, Oregon 97331-4003.

Much of the content of introductory chemistry is interesting only to its teachers, to a few academically inclined students, and to those few students fortunate enough to have charismatic teachers. Its irrelevance is not inherent in chemistry but in our choice of what facets of chemistry we present in the first year. This is dictated by tradition, stabilized by the publishing industry, and solidified by the difficulty of writing exam questions on subjects that are actually useful.

A program will be outlined that could alleviate the problems, and interest more students in chemistry. IUPAC or UNESCO may cooperate with ACS in this, or assume the task unilaterially if ACS is disinterested.

086 WHERE HAVE ALL THE MAJORS GONE? J. J. Lagowski, Department of Chemistry, The University of Texas at Austin, Austin, Texas 78712.

The majors are still there. The thesis is developed that the subject has "lost itself" by not maintaining its centrality in the area of chemical sciences.

087

BUILDING BONDS: DEVELOPING A COMMUNITY OF CHEMISTS. William S. Harwood, Director of Undergraduate Programs, Department of Chemistry and Biochemistry, University of Maryland, College Park, MD 20742.

There is widespread concern about the drop in the number of students choosing to major in the chemical sciences. Large universities in particular have been singled out as a group doing a poor job of preparing students for advanced study in chemistry. At UMCP we feel that students are attracted to a major in part by the attitude that they sense from the department. Students want to be challenged without being dehumanized. We are addressing these concerns by establishing ourselves as a community of scholars who care about one another as well as our science. This talk will examine the variety of approaches we are taking to involve students in the program. Preliminary information concerning numbers and retention will also be discussed.

088 CHEMISTRY IN THE COMMUNITY: WHAT'S IT ALL ABOUT?, M.K. Turckes, ACS, Education Division, 1155 16th Street, NW, Washington,DC, 20036

ChemCom is a year long, discipline-based chemistry course designed primarily for college-bound high school students who do not plan to pursue careers in science. It emphasizes the impact of chemistry on society by addressing chemistry-related technological issues that are relevant to the community and society in which the student lives. An overview of the course will be presented. Discussions will include an introduction to the philosophy and goals of the course, decision-making activities, and student assessment. This session is designed for those who wish to become more familiar with the curriculum--not for the practicing ChemCom teacher.

089 TAKING CHEMCOM TO THE FIELD. Marge Christoph, Clair Clawson, John Wilcox, Nancy W. Brickhouse, St. Mark's High School, Pike Creek Road, Wilmington, DE 19808

High school chemistry has become increasingly abstract and theoretical, giving the impression that the content has no relevance for ordinary people. The textbook problems often deal with only esoteric problems that would only be encountered in a textbook. Textbook problems have one right answer and are routinely solved by a single, explicitly taught method.

The presenters in this demonstration session are ChemCom teachers who have enriched their chemistry courses by working with their students to solve a local environmental problem. Using resources from the local environmental center and the University, we have developed experiments the students can use to find out what the problems are that are affecting the stream located near their school. We will also describe how this type of activity influenced the motivations and understandings of the diverse groups of students who worked with it. Although the unit was developed by ChemCom teachers, it would be applicable for any high school chemistry course.

090

CHEMCOM AS A COLLEGE COURSE FOR NON-SCIENCE MAJORS. Curtis C. Wilkins, Chemistry Department, Western Kentucky University, Bowling Green, KY 42101.

ChemCom chemistry was offered to students at Western Kentucky University as a course which could be used for general education requirements (by non-science majors) in the science field. Four of the eight units in ChemCom were covered and students received three semester credits. The "ChemCom Approach" with its heavy emphasis on lab activities represented a radical departure (for us) from our traditional three-credit lecture course. An outline of the course we offered will be given and some thoughts on substituting this non-traditional type of course for our well-established traditional course will be presented.

091 SOAPS AND DETERGENTS IN HARD WATER, A LABORATORY FOR NON-SCIENCE MAJORS. Pamela Fier-Hansen, Department of Chemistry, Southwest State University, Marshall, Minnesota 56258

Soaps work very well in soft water, but tend to be ineffective cleansers in hard water because they form precipitates with calcium, magnesium and iron ions found in hard water. Builders can be added to precipitate the hard water ions and thus improve the ability of soap to work in hard water. Detergents work well in both hard and soft water. The difference in the ability of soap and detergent to work in hard water is compared in this laboratory.

This simple laboratory exercise was developed for Everyday Chemicals, a general studies course at Southwest State University. It takes about 20 minutes to perform, and all supplies can be purchased at a grocery or drug store. It could be easily adapted to a high school laboratory.

092 USE OF A SPREADSHEET FOR THE STATISTICAL ANALYSIS OF DATA IN THE PHYSICAL CHEMISTRY LABORATORY, John C. Hansen and Pamela M. Fier-Hansen, Chemistry/Physics Department, Southwest State University, Marshall, MN 56258

We have developed a spreadsheet template and accompanying macro for LOTUS 1-2-3 for doing general linear regressions. The template allows one to fit data to a linear combination of any number of user-specified functions. The fits may be weighted or unweighted. The application to two physical chemistry experiments is discussed. In the first, the vapor pressure of a liquid as a function of temperature is used to determine the heat of vaporization. In the second, molecular constants of a diatomic molecule are determined from its gas-phase infrared spectrum. We believe that our method of analyzing the infrared data is both simpler and more instructive than traditional methods.

093 MOLECULAR QUANTUM MECHANICS AND COMPUTER GRAPHICS IN THE PHYSICAL CHEMISTRY LABORATORY. George C. Shields, Department of Chemistry, Lake Forest College, Lake Forest, Illinois 60045.

Physical Chemistry students often have a difficult time appreciating Quantum Mechanics. This difficulty stems from the fact that students do not grasp how quantum mechanical methods can be utilized for molecules bigger than two or three atoms. In an attempt to overcome this problem, students in the physical chemistry laboratory have learned to use the MOPAC package, on a VAX computer, to calculate structural parameters and heats of formation for molecules of interest. These calculated quantities are then compared with literature values. Students build the initial structure on a MacIntosh II computer using the program Alchemy II, and the results of the semi-empirical quantum mechanical calculations are displayed using Alchemy as well. One student in the fall Quantum Mechanics class undertook a research project on the hydroxyalkyl radical during the spring semester. Results of this project will also be presented.

094 DETERMINATION OF THE EFFECTIVENESS OF A PROGRAM DESIGNED TO ENCOURAGE ELEMENTARY TEACHERS TO TEACH SCIENCE IN A HANDS-ON MODE. Robert L. Hartshorn and Phillip H. Davis, The University of Tennessee at Martin, Martin, Tennessee 38238.

In 1987 a three cycle NSF-funded program, designed to train elementary teachers in the use of a hands-on science teaching strategy, was initiated across the state of Tennessee. An effort to ascertain how effective this program has been with the participants will be reported in this session. By comparing the teachers' self-evaluations and their principals' assessments an attempt was made to determine how "comfortable" the teachers have become with the "hands-on" methodology. The impact on their own schools and the influence they have had on neighboring schools will be reported. In particular, an analysis of the lasting effect of this program on the quality of instruction in their own classes will be featured. Videotape documentation will be provided to illustrate the types of changes in elementary science instruction being provided by these teachers.

095 A HYPERCARD SIMULATION OF LIQUID SCINTILLATION COUNTING FOR THE UNDERGRADUATE BIOCHEMISTRY LABORATORY. Nancy L. Devino and George C. Lisensky, Dept. of Chemistry, Beloit College, Beloit, WI, 53511.

Radioisotopes are used regularly in all aspects of biochemical and biomedical research, so it is important that students be familiar with their proper use. In recent years, Beloit College has not provided students with this experience, due the expense involved in maintaining a license with the Nuclear Regulatory Commission and in disposing of radioactive materials. Our current Biochemistry lab manual includes a mock radioisotope lab, which focuses on the analysis of liquid scintillation data. We have designed a Hypercard simulation to replace this lab project. The program simulates the control panel and sample chamber of our Beckman LS-100C liquid scintillation counter. Variables include isotope (^{14}C, ^{3}H, or ^{32}P), dilution factors, counting time, and sample position within the chamber. Hypercard was selected for its graphic interface and flexibility for student input commands in any order. A sample data set allows the student to learn to run the software, and several topics are addressed under the "help" function. The program generates a set of counts-per-minute values, with random variation around a preset value. This provides a unique data set each time the program is run, ensuring that each student has done his or her own calculations.

096 SILVER ION EQUILIBRIA DEMONSTRATION WITH NERNST EQUATION AND NINE EQUILIBRIUM CONSTANTS, Robert H. Anderson, Chemistry Department, Western Michigan University, Kalamazoo, Michigan 49008.

A modification of a demonstration described by Shakhashiri, Dirreen, and Juergens in 1980 and originally proposed by Schwenk in 1959 can with very little additional effort yield a quantitative measure of the silver ion concentration after each of the 9 steps. The amounts of each precipitating reagent have been changed to assure an excess after each reaction in the sequence. From this data the six solubility products and three formation constants of complex ions can be readily calculated. The entire demonstration can be done in 20 minutes or less depending on the amount of explanation. This modified demonstration gives more results with less effort than any other demonstration with which I am acquainted.

097 USE OF LOTUS 123 IN PHYSICAL CHEMISTRY LABORATORY. P. Nambi, Joseph Bean, Will Mann, Department of Chemistry, Mercer University, Macon, Georgia 31207.

Traditionally physical chemistry laboratory calculations have been considered, perhaps, the most difficult of all calculations encountered in the undergraduate courses. In this poster, we describe the use of the spreadsheet program Lotus 123 in the physical chemistry laboratory. Lotus 123 has been used to collect, analyze and display data in a number of physical chemistry experiments. We will discuss the advantages of using spreadsheet programs in the laboratory.

098 INTERACTIVE VIDEODISC COMPUTER AIDED INSTRUCTION FOR THE MICROSCALE ORGANIC CHEMISTRY LABORATORY. Charles E. Sundin, Department of Chemistry, University of Wisconsin-Platteville, One University Plaza, Platteville, WI 53818-3099.

Pre-Class description and discussion of laboratory apparatus and procedures are routinely achieved using the laboratory textbook and/or instructor prepared handouts. However, the demonstration of actual techniques is much more difficult. Film, slides, and videotape have been used but such linear media have limitations. In conjunction with a computer, videodisc's random access capability, durability, and simplicity of use overcomes the limitations. We have produced a prototype microscale organic chemistry laboratory videodisc which includes the basic techniques in Mayo, Pike, and Butcher's Microscale Organic Laboratory. Interactive lessons for pre-lab instruction and post-lab review of microscale organic techniques will be demonstrated.

099 AN INTERACTIVE HYPERCARD ORGANIC MECHANISM TUTORIAL R.W. Kleinman, Department of Chemistry, Lock Haven University of PA, Lock Haven , PA 17745

Learning organic chemistry requires a grasp of the dynamic nature of organic reaction mechanisms. The traditional method of teaching via textbooks and blackboards is, by its nature, static, and causes the student to focus mostly on the beginning and end of a chemical process and not the path by which the process occurs. Learning is also facilitated by an interactive environment, but the use of large lecture sections prohibits student involvement in the learning process to a large extent. To show the dynamic nature of organic reactions and to involve the student in the learning process, an interactive Hypercard tutorial has been developed to guide the student through the steps of a number of organic mechanisms. The tutorial uses questions the student must answer in order to continue with the mechanism and animation to show the changes that take place as starting material changes to product. To help the student better see the relationship between seemingly unrelated reactions, essentially the same questions are used for all mechanisms.

100 MICROBOILING POINTS USING THE MEL-TEMP^{R} MELTING POINT APPARATUS. Bjorn Olesen, Department of Chemistry, Southeast Missouri State University, Cape Girardeau, MO 63701.

The Mel-Temp^{R} melting point apparatus has been successfully used to determine boiling points using the microboiling point technique introduced by Mayo, Pike, and Butcher. (A videotape presentation.)

101 CHEMICAL INVENTORY CONTROL. Wyman K. Grindstaff and Christine J. Edwards, Department of Chemistry, Southwest Missouri State University, Springfield, Missouri 65804.

Chemical inventory is an arduous task for many chemistry teachers in small to medium-sized departments. Computers are the obvious solution to the problem, but this could be an expensive solution. We have found that inventory control is a good use for an Apple IIe microcomputer which otherwise might get little use in today's world of main-frame terminals, Macintosh and MS-DOS systems. We use an enhanced unit with memory expansion to 256K and the spreadsheet from the Appleworks integrated software package. Organic and inorganic compounds are included in separated files which are then subdivided into the storage areas of our storeroom. Reports are generated that list all compounds, subdivisions and use patterns. Abbreviated reports will be presented as a part of this paper.

102 AWARD-WINNING CHEMISTRY SOFTWARE. Robert B. Kozma and Jerome Johnston, NCRIPTAL University of Michigan, 2400 School of Education, Ann Arbor, Michigan 48109.

In 1987, the EDUCOM/NCRIPTAL Higher Education Software Awards Program was established. The program brings pedagogical and disciplinary experts together to evaluate software and curriculum innovations using computers. It is supported by major hardware and software companies and benefits from the participation of fourteen academic associations, including the American Chemical Society. This poster session will describe the procedures and criteria used to select the award winners. It will announce the 1990 award winners in chemistry and present video summaries of chemistry software that won awards in 1987-1989.

103 MICROSCOPY: WHY NOT ULTRAMICRO... Walter McCrone, McCrone Research Institute, 2820 South Michigan Ave., Chicago, IL 60616

104 INTRODUCTION TO THE FIPSE FOLLOW-UP SYMPOSIUM. John W. Moore, Department of Chemistry, University of Wisconsin-Madison, 1101 University Avenue, Madison, WI 53706.

The FIPSE Follow-Up Symposium was conceived as a logical extension of the FIPSE Lecture Series presented at the Tenth Biennial Conference on Chemical Education. Rather than present more lectures *about* technology, however, we decided to involve attendees directly with the technology in the same manner that students would be involved. This means that presenters will not talk *about* what they have done but rather will provide attendees with direct experience of what presenters' students have done. Attendees will carry out experiments, interact with computers and videodisc images, and even be examined by computer. Because of this direct involvement, only a limited number of attendees (50 per session) can be accommodated, and admission to the hands-on sessions will be by ticket only. Presenters have been selected from the ranks of those who are users, but not developers, of the technological materials they will present.

105 ADVANCED TECHNOLOGY LECTURE HALL. INSTALLATION AND STARTUP; Kenneth E. Bower, Cynthia W. Porter, Robert Ferrante, Charles Bower, and Roger W. Strassburg; Department of Chemistry, The University of Akron, Akron, OH 44325-3601.

We have used the audio-visual technique of today's television studio to enhance the traditional science lecture and create an exciting program of instruction for freshman chemistry students. The program, in its first year, is well received by our entering freshman class of over 900 students.

Large lecture halls are not user friendly for either student or instructor. The instructor is challenged to be heard and to keep the attention and interest of his large audience. We addressed each of these opportunities for improvements. We use a theater style video projector to display the output from computer generated IBM Story Board^{R} slides, VHS tapes, interactive video, computer programs, or 35 mm slides. Live demonstrations on camera provide added impact with close-up images on the theater-size screen. There is clearly less classroom noise and more student attention to a multimedia, change-of-pace lecture.

Teaching assistants have a much larger role in the preparation and conduct of the multimedia lecture. We will present a pictorial review of the equipment and a mini-lecture which will interleaf Story Board^{R} slides, interactive video, VHS and live demonstration.

106 INTERACTIVE VIDEODISC COMPUTERS AND THE EXPLORING CHEMISTRY LESSONS. John J. Fortman, Department of Chemistry, Wright State University, Dayton, OH 45435.

Students in our general education chemistry course for non-science majors were allowed to spend time on our one system for extra credit. Topics used were gases, reactions, and solubilities. Student response was extremely favorable.

Participants will be asked to use their knowledge of solubilities and jump ahead to do a 3- or 4-beaker unknown under the Solubilities section of Disc 3 on Chemical Reactions and Solubilities prepared by Loretta Jones and Stanley G. Smith of the University of Illinois and marketed by Falcon Software, Inc.

107 KC?DISCOVERER AS A CLASSROOM CATALYST. Karen E. Eichstadt, Peter J. Tandler, and Douglas C. Rader, Ohio University, Athens, OH 45701.

A series of exercises for General Chemistry utilizing KC?Discoverer have been developed and incorporated into the curriculum. Organizational methods for implementing computer exercises with large groups will be discussed as well as completing the exercises themselves. Of particular note is the ability of KC to provide a vehicle for new methods of self-expression and creativity for student and instructor alike. Participants will experience active learning, questioning, and discovery with the information present on KC.

108 LECTURE EXPERIMENTS USING INTERACTIVE VIDEODISC. John I. Gelder, Department of Chemistry, Oklahoma State University, Stillwater, Oklahoma 74078.

Several videodiscs are currently available that are appropriate for use in an introductory chemistry course. The Periodic Table Videodisc (*JCE: Software* **1989** Special Issue 1), offers a visual database of the majority of elements in the periodic table. The Gases videodisc (one of three available from Falcon Software) includes video segments demonstrating macroscopic properties of gases. The combination of these two videodiscs can be used to introduce gases and to collect experimental data to demonstrate macroscopic properties of gases.

I have just completed the first year of teaching an advanced-placement chemistry course that was distributed by satellite to rural high schools throughout the United States. The course consisted of live 45-minute broadcasts three days of the week and experiments, performed at the high school, two days of the week. Teaching such a course using television presented many problems, including how best to use lecture experiments effectively. I will demonstrate how these videodiscs are used in a lecture environment under the control of a Macintosh microcomputer and Hypercard software.

109 EXTENDING THE LABORATORY VIA INTERACTIVE VIDEO. Gery Essenmacher, Steven Gammon, and Teresa Anderson, Department of Chemistry, University of Wisconsin-Madison, 1101 University Avenue, Madison, WI 53706.

The general chemistry laboratories at the University of Wisconsin-Madison have for many years included an experiment titled "Periodic Properties of the Elements" by Edwin M. Larsen and Larry Haskin (REAC-083, Chemical Education Resources, Inc. P.O. Box 357, 701 Colony Drive, Palmyra, PA 17078). In this laboratory students make direct observations of chemical reactions and properties and correlate them with the periodic table. For example, Li, Na, Mg, and Ca are reacted with water. Using interactive videodisc materials (The Periodic Table Videodisc and KC? Discoverer *JCE: Software* **1989** Special Issue 1 and **1988** *1B*(1)) we have extended this laboratory to include other elements (e.g., K, Sr, Ba) and other reactions (with acids, with base), thereby greatly broadening students' appreciation of periodicity of chemical reactivity of the elements.

110 **RADIATION AND SOCIETY.** Rosalyn S. Yalow, Ph.D., Solomon A. Berson Research Laboratory, Veterans Administration Medical Center, Bronx, New York 10468.

Natural exposure to ionizing radiation has always been with us and there are groups of people who have been exposed to 10 times the usual natural background with no detectable harmful effects. Follow-up studies of the survivors of the Hiroshima-Nagasaki bombing through 1982 revealed that there was only a 6-7% increase in cancer above that expected in the absence of acute radiation exposure. Furthermore, tumorigenesis in animals is generally lower when given at lower dose-rates. Follow-up of patients receiving ^{131}I-uptake diagnostic tests that delivered 60 rem to the thyroid revealed no increase in thyroid cancer. A follow-up study of 36,000 hyperthyroid patients demonstrated no difference in leukemia incidence between those treated surgically or with ^{131}I, the latter having received 10 rem total body radiation. Other studies will be described demonstrating that radiation exposure is a much weaker carcinogen than the the general public believes it to be.

111 INTRODUCTION TO NUCLEAR MEDICINE IMAGING AND RESEARCH. Dennis P. Swanson, M.S., School of Pharmacy, 1100-6 Salk Hall, Pittsburgh, PA 15261.

In diagnostic nuclear medicine studies, small amounts of various radioactive drugs (radiopharmaceuticals) are administered directly to patients. For a given diagnostic procedure, the characteristics of the radiopharmaceutical used are such that it will localize preferentially in the organ or disease process under investigation. Radiations emitted from the localized radiopharmaceutical can be used to produce a "picture" of the area-of-interest using a special imaging device (gamma camera). Alterations in the normal biodistribution of the radiopharmaceutical are indicative of a disease process.

Nuclear medicine research efforts are commonly directed at the development of new and improved radiopharmaceuticals or imaging instrumentation and computer software. Radiopharmaceutical research can involve several disciplines including chemistry, biochemistry, immunology, health physics, pharmacy, and medicine. Instrumentation research is typically performed by engineers, physicists, computer scientists and programmers, and nuclear medicine physicians. Continual progress in both of these reasearch areas is required for the advancement of nuclear medicine.

112 RADIOCHEMISTRY AND POSITRON EMISSION TOMOGRAPHY (PET). M.J. Welch, Washington University School of Medicine, St. Louis, Missouri 63110.

Positron emission tomography (PET) is a medical imaging technique which assesses biochemical processes in the living subject producing images of function rather than form. Using PET, one is able to obtain not the anatomical information provided by other medical imaging techniques (for example x-rays, ultrasound, computed tomography, magnetic resonance imaging) but images of physiological activity. In PET studies, short-lived radionuclides that decay by emitting a positron (positive electron) are produced in a cyclotron and these nuclides are then incorporated by the chemist into molecules of physiologic or pharmacologic interests. These compounds (or radiopharmaceuticals) after inhalation or infusion travel through the subjects blood stream serving as tracers of normal or abnormal physiological activity. The labeling of molecules with short-lived radionuclides provides a challenge to the chemist and these challenges will be described. PET is a rapidly expanding field and presently there are many job opportunities for individuals trained in radiochemistry. The types of opportunities available will be described.

113 THE USE OF RADIOISOTOPES T DETERMINE GROWTH RATES OF MARINE ORGANISMS: A CASE STUDY OF THE CHAMBERED NAUTILUS. J. K. Cochran, Marine Sciences Research Center State University of New York, Stony Brook, New York, NY 11794-5000, N. H. Landman American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024

The growth rate of marine organisms is of considerable practical importance yet is often difficult to determine. One approach is to use radioisotopes dissolved in sea water as clocks to determine growth rates. Organisms which secrete a calcareous shell can incorporate these radioisotopes during shell formation. Once incorporated in a given growth increment of shell, they are isolated from their sea water source and undergo radioactive decay. Two classes of radioisotopes are of use: 1) those produced naturally in the oceans from decay of uranium and thorium and 2) those added by human activities such as atomic weapons testing. We have used both types of radioisotope to determine growth rates of the chambered nautilus. The results indicate that the nautilus takes several weeks to a year to form a chamber (depending on growth stage of the animal) and lives for 10-15 years. This is a slower growth rate and longer lifespan than most other cephalopods such as the squid and octopus.

114 ON THE USE OF RADIOACTIVE DRUGS TO UNDERSTAND BRAIN CHEMISTRY. R.J. Hitzemann, Department of Psychiatry, SUNY at Stony Brook, Stony Brook, New York 11794-8101

Radioactive drugs have contributed greatly to an understanding of brain chemistry. Such compounds are useful to detect the sites (receptors) where drugs bind in the brain. For example, by studying the binding of ^{3}H-cocaine or amphetamine, it has been possible to show that the addictive (reinforcing) properties of these potent central stimulants is associated with a specific neurotransmitter (dopamine) system. ^{3}H-phencyclidine (PCP) binds to quite different sites in the brain - one associated loosely with the endogenous opiod systems, and one associated with the excitatory amino and neurotransmitters. The binding of the hallucinogens such as ^{3}H-LSD, is yet to a different set of receptors, those associated with the brain serotonin systems. ^{3}H-drugs are also used to test hypotheses regarding the pathology of psychiatric disorders. By studying post-mortem the binding of ^{3}H-antipsychotic drugs to the brains of schizophrenics, it has been possible to show that at least some schizophrenics have significantly more dopamine receptors (which could account for the psychotic symptoms). Overall, one can clearly conclude that the impressive progress in the neurosciences over the past 20 years would have been impossible without radioactive compounds.

115 POLARIZED LIGHT MICROSCOPY - TECHNIQUES I. Gary J. Laughlin, McCrone Research Institute, Chicago, IL 60616-3292.

The compound light microscope takes many forms. In biology and medicine it is designed to reveal fine detail of plant and animal tissue. Metallurgists use an inverted microscope or metallograph to examine the fine detail of opaque metal specimens. Mineralogists and chemists use a polarized light microscope (PLM) to characterize, identify and compare small objects in many fields from chemistry to criminalistics. The PLM is fitted with two polarizing filters and a rotating stage for orientation of the objects being viewed.

Before the PLM can be used effectively the sample is prepared for best viewing and study. Small particles are immersed betwen microscope slide and coverglass in a liquid of appropriate refractive index. Some are dissolved in a drop of solvent on a slide and recrystallized; other melted and allowed to crystallize on cooling; more massive hard substances are sliced with a diamond saw then ground thinner and polished to yield a thin section; softer substances are cut with a microtome to prepare their thin section.

None of these techniques requires costly equipment and even the PLM can be an easily modified biological microscope at a negligible cost.

116 POLARIZED LIGHT MICROSCOPY - TECHNIQUES II. Stephen Skirius, Department. of Chemistry, Florida State University, Tallahassee, FL 32306-3006.

Polarized light microscopy (PLM) is an assembly of techniques for the characterization of solid substances. Often, such are very small, even single subnanogram particles. The polarized light microscopist can characterize and identify such samples but the chief advantage of PLM is its speed and dependability of its techniques. No other instrument yields such a rich assortment of identifying characteristics. Observations made routinely include size, shape, surface texture, transparency, color, refractive indices and an array of optical properties dependent on the use of polarized light. Any substance can be examined by PLM: small particles directly; rocks and minerals by grinding and polishing thin sections; softer solids by microtome-cut sections; and organic compounds by thermal methods. In addition, chemical reactions can be performed on a microscope slide. Phase and composition diagrams are also readily determined. Finally, important industrial products and processes can be studied for quality or to correct faults.

117 APPLICATION OF THE POLARIZED LIGHT MICROSCOPE IN THE FORENSIC LABORATORY - HAIR, FIBERS AND THE ATLANTA MURDERS. Larry Peterson, Georgia Bureau of Investigation, Division of Forensic Science, P. O. Box 370808, Decatur, GA 30037

The forensic microscopist studies trace evidence: small particles of drugs, explosives, soil constituents, fibers and hairs and paint pigments. Most of the traces are very tiny particles, light in weight and small in number. the polarized light microscope is the ideal and almost the only instrument for their study. Hairs and fibers are an excellent subject to show the uses of the PLM in the detection and solution of crimes. The Atlanta murders, in turn, is an excellent example of a major crime, whose solution depended to a large degree on hair and fiber evidence. Over a several year period during the middle 1980s, a series of nearly 30 murders of young black males shocked the world and alarmed Atlantans. Very extensive police investigation included collection and examination of fibers and hairs from each of the victims. The homes, cars and clothing of many suspects were carefully examined for similar fibers and hairs. Eventually, fibers and hairs from the home, cars and clothing of one suspect, Wayne Williams, showed many incriminating similarities. this evidence, based on the PLM investigation, convinced the authorities to charge Williams and he was convicted and sentenced to life imprisonment.

118 APPLICATION OF CHEMICAL MICROSCOPY IN THE CRIME LABORATORY - SOILS, MINERALS AND MURDERS. John Kilbourn, State Police Forensic Laboratory, Huntsville, AL 35801.

Soil minerals are an important type of trace evidence in all Police crime labs and the polarized light microscope is the ideal tool for characterizing, identifying and comparing the tiny particles present in soils. Soils vary considerable from one part of the country to another and even one part of town to another. Small amounts of soils (dirt) are picked up on our shoes, car or truck tires or by any object coming into contact with the ground. Each sample consists of a variety of chemical and biological components. Each such particle is recognized by the forensic microscopist using the polarized light microscope. The aggregate of these components, their size and their percentage composition characterized that sample and its location. For these reasons, soil samples have been important in the solution of many crimes and the conviction of many criminals.

119 APPLICATIONS OF CHEMICAL MICROSCOPY IN THE FORENSIC LABORATORY - DRUGS. Joe Koles, Drug Enforcement Agency, Washington, D.C.

One of the most difficult trace evidence areas is drug (controlled substances) identification Because the American public manages self-abuse with several hundred different drugs, their identification by polarized light microscopy (PLM) is complex. Long practice and study is required to develop confidence in the PLM identification procedures. Most forensic investigators, even otherwise competent light microscopists generally turn instead to other techniques such as gas chromatography combined with mass spectroscopy. PLM is, however, still a potent tool in trained hands for the certain technique. At the very least, it is often used for the rapid detection of specific, most commonly used drugs such as cocaine and heroin. The PLM methods used by successful drug analysts include measurement of the distinctive optical properties shown by all drug crystals or the use of chemical reactions on a microscope slide. These microcrystal (or microchemical) tests have a long history of successful application to drugs.

120 THE PLACE OF INORGANIC CHEMISTRY IN THE NEW DEGREE OPTIONS OF THE COMMITTEE ON PROFESSIONAL TRAINING (ACS). Herbert D. Kaesz, Department of Chemistry and Biochemistry, University of California, Los Angeles, CA 90024-1569.

The new degree options in the 1988 Extension of the 1983 CPT Guidelines are each expected to contain a common 3-year chemistry core curriculum consisting of a minimum of 28 semester credit-hours. Elementary and intermediate inorganic chemistry is expected to receive comparable emphasis with other basic areas listed in the core. Assuming an introductory course contains elementary principles of chemical bonding, thermodynamics, and some descriptive inorganic chemistry, a one semester or two-quarter intermediate level course should also be offered in the core. Such a course may be "pre-P. Chem.", and would necessarily require that some of the topics which in the past have been included in a typical "Advanced Inorganic Chemistry" course be incorporated into an integrated advanced course. CPT has invited the Division of Inorganic Chemistry to advise on the contents of such a one semester or two-quarter intermediate course. Proposals by the Division will be presented by another speaker in this program.

121 WHAT TOPICS SHOULD BE COVERED IN THE INTERMEDIATE INORGANIC COURSE? John G. Verkade, Department of Chemistry, Iowa State University, Ames, IA 50011.

The 3-year chemistry core in the new ACS CPT degree options contains a requirement for elementary inorganic chemistry (presumably covered in an introductory first-year course) and a course in intermediate inorganic chemistry. The question regarding the topical content of the intermediate inorganic course has been the subject of considerable discussion in the inorganic community over the past two years. An accompanying question is that regarding the timing of the course - should it be pre- or post-P. Chem? A subcommittee was constituted by the ACS Division of Inorganic Chemistry (DIC) to determine whether a consensus on these issues could be reached. The proposals made to the DIC by its subcommittee will be presented and discussion will be invited.

122 CATALYZING SOLID-STATE CHEMISTRY INSTRUCTION. Arthur B. Ellis, Department of Chemistry, University of Wisconsin-Madison, Madison, WI 53706

With the support of the ACS Division of Inorganic Chemistry, a national ad hoc committee has been formed, having as its goal the creation of instructional material for solid-state chemistry. Results of a national survey, conducted to ascertain what materials are needed, will be presented. An update of the committee's activities will be provided.

123 INORGANIC CHEMISTRY FOR BIOCHEMISTS: AN IDEA WHOSE TIME HAS COME? B. A. Averill, Department of Chemistry, University of Virginia, Charlottesville, VA 22901

Recent developments in the hybrid field of bioinorganic chemistry (or metallobiochemistry) have demonstrated the fundamental importance of inorganic chemistry to an understanding of a wide variety of biochemical systems and processes. A brief overview of the role of metal ions in biological systems and "inorganic" metabolism will be presented, followed by a consideration of which aspects of basic inorganic chemistry should be included in a sophomore-level course designed for the biochemistry-option ACS major. Finally, some suggestions will be made regarding ways to enrich more traditional freshman- or senior-level inorganic courses with topics from bioinorganic chemistry.

124 INCLUDING INORGANIC DIVERSITY IN THE ACS INORGANIC EXAM(S). John M. DeKorte, Department of Chemistry, Northern Arizona University, Flagstaff, AZ 86011, Current Chair ACS Inorganic Examination Committee.

The inherent diversity of the field of inorganic chemistry and the diversity of approaches currently being used to satisfy the ACS requirement of one year of inorganic chemistry for ACS Certified Chemistry majors has caused some difficulties in creating a representative standardized examination. The manner in which this has been addressed in working to produce the 1991 version of the ACS Inorganic Examination will be discussed. The committee has incorporated more bioinorganic, organometallic, and solid state questions in the forms that are currently being pre-tested. The overall composition of the pre-test forms, and the results of the pre-testing will be discussed. Finally, time will be given for audience discussion concerning the need for developing an examination which tests basic inorganic chemistry and a separate examination which tests advanced inorganic chemistry.

125 THE MULTI-FACETED ROLE OF A FRESHMAN LABORATORY COORDINATOR. F.E. Wood, Department of Chemistry, University of California, Davis, California 95616.

Many large universities employ individuals to serve as coordinators of the freshman laboratory program. While the actual responsibilities of these individuals vary greatly at each university, each coordinator tends to have many responsibilities that would not be immediately obvious from the position title. The Freshman Laboratory Coordinator position at U.C. Davis does indeed involve many varied responsibilities, including class scheduling and enrollments, supervision and training of teaching assistants, creation and maintenance of experiments, creation and maintenance of student and instructor manuals, supervision of laboratory grading, and coordination with faculty members. The integration of these and other ongoing responsibilities will be discussed along with new responsibilities that are presently being proposed.

126 A COG ON A WHEEL IN THE GENERAL CHEMISTRY MACHINE. Patricia A. Metz, Department of Chemistry, Texas Tech University, Lubbock, TX 79409

Managing a large general chemistry program is analogous to running an intricate machine of human wheels. The wheels are students, faculty, graduate and undergraduate teaching assistants, course supervisors, prep-lab staff, office and storeroom personnel, and part-time instructors, among others. Each wheel has a vital function in the operation of the program and each wheel works best when all its cogs or individuals are properly maintained. The person ultimately responsible for keeping the cogs primed is the coordinator of general chemistry. Sometimes, though, the coordinator fails to recognize the smooth operation of the cogs or hear them grinding at the wheels because the cogs are buried in the system. This talk is focused on the general chemistry machine from the dual perspective of a person who has been a cog on many different wheels and who will now run the machine.

127 IN SEARCH OF THE LOST CHORD: COORDINATING THE GENERAL CHEMISTRY PROGRAM AT SMU. Thomas J. Greenbowe, Department of Chemistry, Southeastern Massachusetts University, North Dartmouth, MA 02747.

An overview of the successes and recalcitrant problems encountered while coordinating the general chemistry lecture and laboratory sections for 900 students at Southeastern Massachusetts University. Our general chemistry personnel consists of ten (more or less) professors, one general chemistry lecture and lab coordinator, several part-time and full-time visiting lecturers, graduate and undergraduate teaching assistants, two chemistry technicians, and several undergraduate workstudy students. The issues to be discussed: obtaining a consensus among the professors for a lecture topic sequence and schedule, sequencing the laboratory experiments to fit the lecture topic sequence, pre-testing students, monitoring the level and pace of the lectures taught by different professors, maintaining equity in exams written by and administered by different professors, peer teaching evaluations, student evaluations, and course evaluations. Also, how we use detailed "technical sheets" to minimize "creative thinking" with our undergraduate work study students as they set-out the equipment and set-up the lab for each laboratory experiment. The unique feature of our "technical sheets" is a statement or two of the reasons why the coordinator wants the lab and the equipment set-up a certain way, and why it may not be a good idea to do it the "easy" way.

128 GENERAL CHEMISTRY COORDINATORS: WHO THE HECK ARE WE? B. A. Sawrey, Dept. of Chemistry, U.C.S.D., La Jolla, CA 92093

Faculty or staff, tenure-track or non-tenure-track, appreciated or abused, by training or by default, permanent or temporary -- the job of coordinating general chemistry (both lab and lecture courses) is one which more and more colleges and universities find requires the full-time attention of a professional. The spectrum of titles and responsibilities of such positions will be explored. Each job is unique and requires special matching with the proper person. Examples of who is doing what as a general chemistry coordinator will attempt to demonstrate the range of methods used by campuses to adapt to the need for such a creature.

129 IMPROVING A FRESHMAN LAB PROGRAM: GOALS AND REALITIES, S.T. Marcus, Department of Chemistry, Cornell University, Ithaca, New York 14853

When the finest students majored in physics and chemistry, rather than in business and pre-law programs, and when our chemistry classes were filled to overflowing, we could afford to offer dull introductory laboratory programs to our students. We can no longer afford to be complacent. Recognizing this, Cornell University has undertaken an ambitious program to rejuvenate the laboratory components of its freshman courses. This talk will discuss the goals, realities, plans and actions associated with that program. Included in the talk will be a brief overview of insights gained as a result of visiting more than thirty different chemistry departments, as well as a description of a number of the experiments developed for the new laboratory programs.

130 THE LABORATORY COORDINATOR AT VASSAR COLLEGE. Christina Noring Hammond, Department of Chemistry, Vassar College, Poughkeepsie, NY 12601.

The Laboratory Coordinator at Vassar College plans the laboratory programs for both general chemistry and organic chemistry, develops and tests experiments, writes the laboratory manual for general chemistry, oversees the preparation for the laboratories by the stockroom personnel and teaches several laboratory sections. The general chemistry laboratory program and the responsibilities of the Laboratory Coordinator as they relate to this program will be discussed.

131 WHY ADVANCED PLACEMENT CHEMISTRY? Ronald D. Archer, Department of Chemistry, University of Massachusetts, Amherst, MA 01003.

During my tenure as an Advanced Placement (AP) Chemistry reader, table leader, and chief reader, I became much more concerned about what happens to high school chemistry students before "we" see them in college. Discussions with high school teachers and students over the past fifteen years have convinced me that Advanced Placement Chemistry has a valuable place in secondary and higher education despite its apparent misuse in some secondary schools. The history, purposes, and uses of AP Chemistry will be briefly reviewed along with a short discussion of the examination, what colleges and universities can do to enhance the knowledge base of the AP student, and why I believe that AP Chemistry teachers who teach AP Chemistry as a second year course are, in general, our best high school chemistry teachers. Am I right?

132 HIGHLIGHTS OF AN AP CHEMISTRY COURSE. A. Joe Clark, Clarke Central High School, 350 S. Milledge Ave., Athens, GA 30606.

This presentation will address specific issues involved in teaching Advanced Placement Chemistry at Clarke Central High School in Athens, Georgia. The discussion will include a description of the school environment, student background, comparison of AP Chemistry curriculum with that of the first year high school chemistry course, teaching strategies for the AP Chemistry course, and administrative support and/or difficulties associated with maintaining the program.

133 AP CHEMISTRY LABORATORY. Frank Cardulla, Niles North High School, 9800 Lawler Ave., Skokie, IL 60077.

This presentation will deal with a number of pertinent topics related to laboratory work in Advanced Placement Chemistry, including various philosophies regarding the proper role of laboratory work in AP Chemistry, the relationships and differences between an AP laboratory program and laboratory work typically done in a 1st year course, equipment and time requirements, techniques of creating additional laboratory time in the traditional high school schedule, typical laboratory programs used at some "successful" AP schools, and the relationship between the AP laboratory program and the AP exam, and how colleges often view the laboratory preparation of AP Chemistry candidates compared to the preparation typically accorded their own students.

134 THE AP CHEMISTRY EXAM - HOW IS IT EVALUATED? Arden P. Zipp, Chemistry Department, SUNY-Cortland, Cortland, NY 13045.

Over 18000 free-response AP Chemistry exams were graded by 45 university and secondary school teachers during a six day period in June. This activity will be described with particular emphasis being placed on the setting of grading standards and the maintenance of consistency on the part of readers.

135 PRESENT CONCERNS. Gregory R. Choppin, Department of Chemistry, Florida State University, Tallahassee, FL 32306-3006.

A 1989 survey of students who took the 1989 Advanced Placement (AP) Chemistry Examination shows that less than 17% of the students who took the examination had the course background and the amount of class and laboratory time that the AP Chemistry Course description brochure recommends. The overall effect produced when large numbers of students with less than adequate preparation in chemistry take the examination is a perception that the AP Chemistry examination is more difficult than AP examinations in other non-science subjects, i.e. a smaller percentage of students receive the generally acceptable grade of 3 or higher. The role of the AP Chemistry Test Development Committee in striking a balance between encouraging the study of advanced science courses in secondary schools and maintaining the high quality of the program will be discussed. Also, the dilemma associated with widespread restrictions in the scheduling of classes in secondary schools and concerns over funding allocations for and safety in the high school laboratory will be addressed.

136 AP CHEMISTRY STUDENTS AT THE UNIVERSITY OF MICHIGAN. M. David Curtis and Seyhan N. Ege, Dept. of Chemistry, Univ. of Michigan, Ann Arbor, MI 48109.

In the past, many AP Chemistry students who had credit for the entire general chemistry sequence were counselled (by non-department counsellors) to not elect organic chemistry in their first term on campus. The rationale was that they should first gain a year of college experience. Consequently, the Chemistry Department never saw many of the over 400 students admitted per year with AP Chemistry credits. This loss of students with interest and excellent background is unacceptable in the current shortage of science students. In the fall of 1989, the Chemistry Department started a new curriculum, the first year of which is a sequence of courses that stress qualitative reasoning skills (vs. mathematical problem solving) and use organic reactions with everyday applications to convey the "way chemists think". AP Chemistry students were counselled to enroll in these courses, since they represent a radical departure from material and approaches in the student's high school background. This presentation will describe the new curriculum and focus on the overall enrollment patterns, grades, successs and retention in chemistry of AP students prior to and after the introduction of the new curriculum. Interviews with students will also be used to assess the efficiency of the new approach to retaining and/or stimulating students' interest in chemistry and the basic sciences.

137 New Tools for Interactive Video. Stanley Smith, Department of Chemistry, University of Illinois, Urbana, IL 61801

TV images stored on a random access video disc have been combined with computer graphics in the development of programs for the teaching of chemistry. New display technology makes it possible to change the size and position of full motion video, in real time, and to display the image on a standard computer monitor. Techniques for creating and using multiple video images on a single display will be demonstrated in instructional programs.

138 CD-ROM AS A STORAGE MEDIUM; Alton J. Banks, Dept. of Chemistry, Southwest Texas State University, San Marcos, TX 78666

The advent of optical media as a storage device has provided a repository for large amounts of information on a single optical disc. The technology of this medium will be briefly explored. Examples of present hardware and software will be given. The possibilities of the medium for interactive instruction will be explored.

139 ENHANCING INSTRUCTION WITH DIGITIZED VIDEO IMAGERY. Loretta L. Jones, Department of Chemistry, University of Illinois at Urbana-Champaign, 601 S. Mathews, Urbana, IL. 61801

Multimedia technologies offer a means of providing students with interactive lessons that expand the curriculum by introducing a broad variety of visual imagery. Video images can be digitized and stored on a computer disk or they can be combined into a master videotape and transferred to videodisc. Digitized video images on a microcomputer disk do not easily allow motion, but offer the advantage of instant recording and updating, without a mastering requirement. Multimedia courseware and tools for the development of classroom presentations using digitized video images will be demonstrated.

140 **Application of Commercial Hardware-Software Packages to Data Acquisition and Control in the Teaching Laboratory**. T.H. Ridgway, Dept. of Chemistry, University of Cincinnati, Cincinnati, Ohio 45221.

The availability of commercial hardware and software for generic data acquisition and control applications has the potential for allowing relative neophytes to implement sophisticated laboratory experiments involving computer aided experimentation.

There are essentially two different vendor approaches that can be recognized. The first is the software vendor who provides drivers which allows a number of different hardware products to interface to their software package. The primary example of this class is the spread sheet interface. A less well known example is a package which interfaces a number of vendors hardware to a MathCad like software package which provides complex data manipulation capabilities, including Fourier transformations. The second approach orginates with hardware vendors who are nov beginning to provide application software. Some of these are quite elegant, providing data manipulation and display, conditional control and even a user designed "front panel" for the software "instrument".

We may now be reaching the point where you won't be able to recognize the pioneers by counting the arrows in their back.

141 **CHEMISTRY AND THE NeXT COMPUTER.** Alfred J. Lata, Department of Chemistry, University of Kansas, Lawrence, Kansas 66045.

The NeXT computer (the 'Cube'), by NeXT Inc., is the latest weapon in the computing arsenal, the first commercial example of the '3M' computer designed for educational purposes.

The hardware aspects of the NeXT computer will be presented and discussed, and the innovative hardware pieces including the 256 Megabyte magnetic optical disc, 1024 x 832 pixel (2 bit) high resolution screen and 400 dot per inch laser writer will be discussed. The hardware and software currently available will be shown and discussed. The use of the Interface Builder and the Application Kit found in NextStep, the object oriented programming system will be shown. Currently available commercial software for the NeXT will be discussed, and applications of this software for use in Chemistry will be illustrated. Contemporary use of the computer at educational institutions, and software used and/or developed at these institutions will be presented and discussed.

142 **DO THEY HEAR WHAT I HEAR: THE KAZOO OF CHEMISTRY .** Alfred J. Lata, Department of Chemistry, University of Kansas, Lawrence, Kansas 66045.

As Chemistry instructors, we write the equations, draw the molecules, solve the problems, and say the words: but in all of this, do the students hear what we hear? (The Music of the Molecules?)

Let us walk a few feet in their shoes. Let's for a few moments put ourselves in a situation where we hear words and see 'equations' unfamiliar to most of us in the 'microscopic', but obvious in the 'macroscopic'. Let's listen to the "Kazoo of Chemistry".

143 THE WORLD OF CHEMISTRY: THE IMPACT ON STUDENT'S COGNITIVE AND AFFECTIVE DOMAINS. Dr. Nava Ben-Zvi. The World of Chemistry , Dept. of Chemistry, University of Maryland, College Park, Maryland 20742

A one page flyer promoting the WORLD OF CHEMISTRY (WOC) telecourse states: "A world of living cells and synthetic materials; a modern world in which society and technology are interdependent; a world of structure of phenomena; this is The World of Chemistry..." This statement expresses the rationale underlying the WOC educational package. We as educators, are concerned not only with the general goals, but with the educational outcomes of the study of WOC. An evaluation study of the WOC materials has been carried out with 4 and 2 year college and university students from different institutions in the United States. The data obtained from faculty and students has been analyzed and compared to WOC's proposed behavioral objectives. Teaching suggestions focusing on students' alternative frameworks and attitudes towards chemistry have been designed.

144 WHAT IS WRONG WITH THE GENERAL CHEMISTRY COURSE? R.J. Gillespie, Department of Chemistry, McMaster University, Hamilton, Ontario, Canada L8S 4M1.

1. The general chemistry course contains too much material and the text books are far too long.
2. It is aimed too much at the chemistry major rather than at the majority of the students in the course who take little if any more chemistry.
3. There is too much difficult abstract theory that can only be very superficially treated because of limitations of time and consequently is not understood by the majority of the students.
4. There is too much emphasis on physical chemistry and not enough on organic and inorganic (reaction) chemistry.

As a consequence many students regard the course as very difficult, uninteresting, uninspiring and irrelevant. Suggestions for a new reduced course content will be discussed.

145 PHILOSOPHY OF CHEMISTRY IN THE U.K. SCIENCE CURRICULUM
F. Michael Akeroyd, Bradford and Ilkley Community College, Great Horton Road, Bradford BD7 1AY U.K.

In Sept. 1989 far reaching reforms were introduced into U.K. science curricula. This paper is a sequel to one presented at the 1st International History & Philosophy in Science Education Conference, Tallahassee, Nov. 1989 and shows how work published by the author (J. Chem. Educ. 1984, 61, 434 and Brit. J. Phil. Sci. 1986, 37, 359) on the philsophy of chemistry could be integrated into normal classroom lessons for students K10→ K12.

146 DESIGN OF A COURSE IN CRITICAL THINKING. John E. Bauman, Department of Chemistry, University of Missouri, Columbia, MO 65211.

A seminar course for honors freshmen is described. The work of W. Perry, M. Belenky and others concerning stages of intellectual development during the college years is applied to instruction at various levels of thinking: complex, contextual and creative. The work of C. Nelson in Biology is applied to chemistry classes. Implications for extension to large lecture sections are made. A reassessment of lecture styles, textbooks, discussion sessions, laboratory sessions and even student evaluations of all these is made.

147 ARE WE TRAINING STUDENTS TO MAKE OBSERVATIONS? John Tanaka and Maria Sedotti Department of Chemistry and School of Education, University of Connecticut, Storrs, Connecticut 06269-3060.

A corollary to Truman Schwartz's "Do we train students to ask questions or answer them" is "Are we training students to observe and record or fill in blanks?" In order to answer this question, the high schools in the State of Connecticut were surveyed to ascertain the type of laboratory experiments used and the techniques employed in carrying out the lab. The high schools in the State were divided into four groups depending on class size. The small high schools (24), had class sizes from 36-98. The medium high schools (116) had class sizes from 100-350. The large high schools(22), had class sizes 350-530. Four high schools were extra large with class sizes of 550 to 715. Questionnaires were sent to all high schools except for those in the medium category. A random selection of 25 high schools was made from this group. Phone calls were made to those not returning the questionnaire. The results, which will be analyzed and discussed, indicate that more needs to be done to train students to make basic scientific observations and to record these observations in a laboratory notebook.

148 THE USE OF "MARATHON" PROBLEMS AS EFFECTIVE VEHICLES FOR THE PRESENTATION OF FRESHMAN CHEMISTRY LECTURES. James H. Burness, Department of Chemistry, The Pennsylvania State University, York Campus, 1031 Edgecomb Avenue, York, PA 17403.

The nature of the typical freshman chemistry course is such that the course is usually best presented by use of the standard lecture approach. If the instructor attempts to provide detailed and complete notes, the student is sometimes so busy taking notes that he or she misses important points of the lecture. Another result of this approach is that students might not see how the topics from a given chapter are related. The purpose of this paper is to present a variation of the "lecture" approach which uses a "marathon" problem to cover the material in a particular chapter. These marathon problems are long, comprehensive and difficult problems which are solved together by the instructor and the students. The problems provide a vehicle for introducing the chapter material, exploring alternative problem-solving approaches, promoting instructor-student interaction during the lecture and, most importantly, seeing how the many concepts and topics in the chapter are integrated into a coherent problem. Several marathon problems and their solutions will be discussed during the talk.

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WRITING IN GENERAL CHEMISTRY. Melanie M. Cooper, Department of Chemistry, Clemson University, Clemson, SC 29634-1905

In many large multisection general chemistry courses, it is a fact that students are assessed mainly on their responses to multiple choice questions. In turn, this method of testing seems to be affecting how students study and learn material. In an attempt to counteract this trend, we have begun a program in which writing assignments are required of the students. Writing can be a powerful tool, with which a student can reason towards the solution to a problem. Clear presentation by the student, of problems with material or new principles, also allows fresh and deeper insights by both teacher and students, in addition to opening up a communication path between teacher and students. The introduction of such writing assignments into large multisection general chemistry courses both in lecture and laboratory will be discussed.

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THE USE OF "WRITING TO LEARN" IN A LARGE ORGANIC LECTURE COURSE **Kenneth O. Pohlmann, Dept., of Chemistry, St. Mary's University, One Camino Santa Maria, San Antonio, Tx. 78284**

This past academic year, students were required to turn in daily lecture summaries of one-two pages. The course had an enrollment of ninety students. The procedures that were followed to accomodate the large class and accompanying paper work will be described. Also, a unique grading scale, entitled **WICK**, designed for the summaries will be presented. The success of this pedagogical approach will be demonstrated by showing a comparison of student performance to past years. Of significance is the observed increase in class averages on exams. Improvement in classroom performance of low ability students will also be shown,

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MICROSCALE GENERAL CHEMISTRY EXPERIMENTS. Michael D. Hampton, Department of Chemistry, University of Central Florida, Orlando, FL 32816, and Jerry L. Mills, Department of Chemistry and Biochemistry, Texas Tech University, Lubbock, TX 79409-1061

Reduced scale, generally termed microscale, experiments have been shown to be very effective teaching tools. This fact along with the enhanced safety, greatly reduced cost, and significantly decreased disposal costs of these experiments is resulting in their increasing acceptance in undergraduate and precollege teaching labs. This talk will focus on microscale experiments for general chemistry laboratories and will discuss the history, practical aspects, and safety considerations of these experiments.

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MICROCHEMISTRY LAB TECHNIQUES FOR HIGH SCHOOL CHEMISTRY. John J. Mauch, Pasco High School, 1108 North 10th, Pasco, WA 99301

Chemistry as an experimental science for the high school is facing several problems, safety, cost of materials, disposal of chemicals, and the appropriateness of lab experiences. The lab is often the most remembered and visible aspect of chemistry. This talk will discuss recent developments in the field of microscale chemistry including the types of experiments that can be done. Since smaller quantities of chemicals are used the expense is about one tenth of a usual experiment along with a quantum leap in the safe manipulation of potentially hazardous substances. Many experiments can be done in one third the time. These experiments use a variety of plastic trays, pipets, cassette boxes, and small culture tubes.

153 INNOVATIVE MICROSCALE LAB TECHNIQUES AND DEMONSTRATIONS, Bob Becker, 7571 Buckingham Drive, #5, St. Louis, Missouri 63105

Recent directives in chemical education have focused on the microscale lab as a cost effective, time efficient, safe, and exciting alternative to many traditional scale laboratories. This presentation will cover a variety of innovative, yet inexpensive, microscale lab techniques and demonstrations and will include a discussion of their versatility and "user friendliness". Topics will include: micro "shake down" kinetics; microscale gas generation, delivery, and testing ; micro extraction and distillation; Cartesian retrievers and "electrolytic divers"; conductivity probes; micro rocket labs; and more.

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MICROSCALE GENERAL CHEMISTRY EXPERIMENTS FOR MACROSCALE CLASSROOMS: A SIMPLE "ACTIVITY SERIES" EXPERIMENT, Marcia Bailey, Department of Chemistry, Central Michigan University, Mt. Pleasant, Michigan 48859, (517) 774-3981.

At Central Michigan University 800 students per year enroll in a lecture/laboratory liberal arts chemistry course entitled "Armchair Chemistry". In each section of 135 students, microscale general chemistry laboratories are integrated with lecture material. In this presentation, a short microscale Activity Series experiment will be shared with be shared with participants. Two different CMU "Armchair Chemistry" lab-lecture applications of this experiment will be described: (a) as an integral part of an Oxidation-Reduction unit, and (b) as a brief part of a Periodic Trends unit, in order to introduce the concept of relative reactivities of two elements.

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MICROSCALE LABORATORY INVESTIGATION. Jerry A. Bell and Linda R. Wolf, Department of Chemistry, Simmons College, Boston, MA 02115.

Developers of microscale experiments and microscale laboratory programs should take pedagogical advantage of the speed, safety, simplicity, and low cost inherent in microscale experimentation. The least useful approach is to use the extra time available simply to add more exercises that demonstrate the concepts outlined in the text. Better is the resurrection of some excellent experimental systems that have fallen into disuse because of safety and/or cost considerations, e.g. experiments with heavy metals, including silver. Best is to develop approaches that enable, encourage, and reinforce student-designed investigations of chemical systems. We shall show examples of our approach which involves short, set-piece exercises to develop techniques followed by open-ended investigations using these techniques.

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REEMPHASIZING THE INORGANIC COMPONENT OF GENERAL CHEMISTRY THROUGH THE USE OF MICROSCALE LABORATORY TECHNIQUES. Zvi Szafran; Ronald M. Pike; Mono M. Singh; Chemistry Department, Merrimack College, North Andover, MA 01845 and Judith C. Foster, Chemistry Department, Bowdoin College, Brunswick, ME 04011.

Descriptive inorganic chemistry has largely disappeared from the general chemistry curriculum, with the general chemistry laboratory essentially becoming an introductory physical chemistry laboratory over the last 20 years. Lately, the American Chemical Society has called for an increased inorganic content in the chemistry curriculum, including general chemistry. Furthermore, many colleges use general chemistry as their introduction to inorganic chemistry, without it adequately fulfilling this function.

We, at Merrimack and Bowdoin Colleges, have developed a new laboratory program in general chemistry, at the microscale level. The goal is an increased emphasis on inorganic chemistry, without neglecting the other areas commonly found in other freshman programs.

This presentation will discuss specific microscale laboratory techniques, several experiments, and the overall ramifications of conversion to this approach.

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MICROSCALE DETERMINATION OF MAGNETIC SUSCEPTIBILITY. John Woolcock, Department of Chemistry, Indiana University of Pennsylvania, Indiana, PA 15705, Zvi Szafran, Department of Chemistry, Merrimack College, North Andover, MA 01845, Ronald Pike, Department of Chemistry, Merrimack College, North Andover, MA 01845, and Mono M. Singh, Department of Chemistry, Merrimack College, North Andover, MA 01845.

There are a number of traditional techniques for determining the magnetic susceptibility of transition metal complexes but only two are practical at microscale level. level. These are the faraday method and the use of nuclear magnetic resonance. More recently, a new type of magnetic susceptibility balance, developed by D. F. Evans and Johnson Mathey/Aesar, has appeared that will also operate at the microscale level using solid, liquid, or solution samples. We will describe the use of this balance with each type of sample and compare the results obtained to those found using NMR. We will also describe a number of microscale synthetic procedures that utilize these magnetic susceptibility measurements as a major method characterization.

158 MICROSCALE SYNTHESIS, REACTIONS AND ANALYSIS OF LEAD(II) IODIDE FROM LEAD(II) CARBONATE. AN ADVANCED GENERAL OR SOPHOMORE INORGANIC CHEMISTRY LABORATORY. Mono M. Singh; Zvi Szafran; Ronald M. Pike. Department of Chemistry, Merrimack College, N. Andover, MA 01845

An advanced general or sophomore inorganic chemistry laboratory dealing with the microscale synthesis of lead(II) iodide from lead(II) carbonate and its subsequent analysis has been developed. This paper will describe the method of preparation and analysis of the titled compound where lead is determined by a micro-gravimetric method or by atomic absorption spectroscopy. The iodide is determined by the precipitation of silver iodide. Remaining lead(II) iodide may be recycled. Student results will also be presented.

159 PREPARATION OF BUTENES BY E_1 AND E_2 ELIMINATION. Bjorn Olesen, Department of Chemistry, Southeast Missouri State University, Cape Girardeau, MO 63701.

Common methods for introducing unsaturation into organic compounds include dehydration of alcohols and dehydrohalogenation of alkyl halides. This laboratory exercise allows students to investigate product ratios obtained from the dehydration of 1-butanol and 2-butanol, and the product ratios obtained from the dehydrohalogenation of 1-bromobutane and 2-bromobutane. The resulting butenes are analyzed by gas chromatography using 10% squalane on Chromasborb W/AW. Students work in groups of four and write a group report. The report must include a mechanistic rationalization of product distribution from each starting material. Student data for the past three years is included.

160 MICROSCALE REACTIONS OF VANILLIN. Rosemary Fowler, Department of Chemistry, Cottey College, Nevada, Missouri 64772.

Even though most applications of organic chemistry are based on complex molecules, few traditional or microscale experiments using reactants with several functional groups are available. We have focused our attention on developing several related experiments that will allow us to study a compound with several functional groups. Our paper will present several microscale reactions, such as sodium borohydride reduction and the Cannizzarro reaction, which we have developed and used in our laboratory to study the chemistry of vanillin (r-hydroxy-3-methoxybenzaldehyde). The products from these reactions, vanillin, vanillyl alcohol, and vanillic acid, have been isolated in good yield and high purity. Comparing the UV, IR, and NMR spectra of these compounds clearly demonstrate to the students the differences between the functional groups.

161 A COMBINATION OF MICROSCALE AND MACROSCALE ORGANIC LABORATORY. R. J. Watkins, Department of Chemistry, Carroll College, Waukesha, Wisconsin 53186.

While the pedagogical, cost, and safety advantages of doing microscale organic experiments have been well documented, there will always be a need to continue doing some macroscale work. This is especially useful as the organic course makes the transition from macroscale to microscale experiments. The recent review (Journal of Chemical Education, January, 1990) of Microscale Organic Laboratory by Mayo, Pike, and Butcher raises a concern about the omission of conventional-scale techniques. Our course addresses that concern by initially having all students do exactly the same experiment on both the micro- and the macroscale level. Thus, they master both sets of techniques for recrystallization, distillation, and liquid-liquid extraction and see the advantages of each. After that, students alternate macro- and microscale experiments with half of the class doing each experiment each way. Student response has been excellent.

162 RECOVERY OF SILVER FROM SILVER WASTE. A.H. Ackerman, J.A. Murphy, and J.K. Heeren, Department of Chemistry, Trinity College, Hartford, CT 06106.

The recovery of silver metal from laboratory waste (mostly AgCl) by several procedures is described. Conversion of the silver to silver nitrate on a semimicro scale for recycling is also outlined.

163 NEW MICROSCALE EXPERIMENTS Gottfried Brieger, Department of Chemistry, Oakland University Rochester, MI 48063

Details will be presented on the adaptation of several synthetic organic experiments to microscale. These include the photodimerization of maleic anhydride, the Diels-Alder reaction of cycloheptatriene, and the synthesis of azulene.

164 A MICROSCALE SUBLIMATOR AND OTHER MICROSCALE DEVELOPMENTS
Anthony Winston, Institute of Microscale Chemistry, Department of Chemistry, West Virginia University, Morgantown, WV 26506.

Vacuum sublimation is one of the most convenient means for purifying volatile solids. Microscale texts include this procedure, but the equipment recommended generally consists of a combination of test tubes, filter flasks, and rubber stoppers. We have developed a one piece, low cost, glass microscale sublimator that fits the 5 mL round bottom flask of the 10/10 standard taper kit. Sublimation is very convenient and a wide variety of materials have been sublimed using the sublimator. Other developments include a low cost IR cavity cell for solution spectra and the application of FTIR in the microscale laboratory. The new microscale sublimator will be available for examination as well as results of the applications of the FTIR.

165 USE OF MICROSCALE MIXTURES AS QUALITATIVE ORGANIC UNKNOWNS. James A. Beres, Department of Chemistry, Shippensburg University, Shippensburg, Pennsylvania 17257.

Our second semester organic chemistry laboratory course for non-chemistry majors traditionally has concluded with the identification of a single unknown. With the increasing emphasis on microscale techniques, we have modified the experiment so that students are given a 1.5 mL two-component mixture. Its separation and characterization includes the following techniques: performing a fractional distillation using a Hickman Still, determining boiling and melting points by micro methods, obtaining and interpreting a mass spectrum and an infrared spectrum, performing some classical functional group tests, and preparing a solid derivative. We have found that the students enjoy the challenge of dealing with a mixture at the microscale level and are usually quite successful in their attempts. The experiment not only introduces the methods of identification but reinforces a number of techniques already learned in the course. It also introduces the use of mass spectrometry as a tool for identification.

166 A NEW APPROACH TO MICROSCALE ORGANIC CHEMISTRY. R. W. Holman, R. K. Hessley, R. Beauvais, S. Bosch, L. Hayes, M. Lyons, and K. Smith, Department of Chemistry, Western Kentucky University, Bowling Green, KY 42101.

Traditional synthetic organic chemistry experimental procedures at the sophomore level include for the student the identity of both the starting material and the end product. The new approach to be described differs in that the identity of the starting material, or the end product, or both, are unknown to the student. In the latter case, the student must interpret supplied (or experimental) spectroscopic data and use it in conjuction with physical property measurements to establish the identity of the starting material. Then, knowing the reaction's mechanism, the student must predict the identity of the end product, and ultimately prove its identity with spectroscopic and physical measurements. This approach will be utilized throughout an upcoming textbook coauthored by the presentor of this paper. Six to eight new experiments will be described using this combined qualitative analysis/synthesis approach.

167 A CONVENIENT, HIGH YIELD METHOD OF ESTERIFICATION. P. Di Raddo, Chemistry Department, Carthage College, Kenosha, WI 53140-1994.

A common undergraduate organic chemistry experiment involves the esterification of carboxylic acids using alcohols and catalytic amounts of strong acids under refluxing conditions for a prolonged reaction time (yields generally ~ 50%). A convenient alternate esterification method will be presented which involves mild reaction conditions and illustrates, in one experiment, some basic principles in synthetic organic, organometallic and biological chemistry. The reaction involved the use of chlorotrimethylsilane in methanol and required minimal purification. A number of saturated and unsaturated fatty acids were esterified in yields superior to 90%. Similarly glycerol was esterified to give appropriate triacylglycerides (~ 70%). Yields were comparable under microscale, 50 mg starting material, and semi-microscale, 500 mg, conditions. Finally several substituted aromatic benzoates were prepared, each one having distinct odiferous characteristics. By "sniffing" the compounds and ranking the particular odors, the students, with much personal satisfaction, could conduct biological testing on their own.

168 NMR IN A MICROSCALE ENVIRONMENT. Clifford M. Utermoehlen and Paul E. Vorndam, Department of Chemistry, United States Air Force Academy, Colorado 80840.

The transition from macro- to microscale for sophomore organic chemistry has been facilitated by the ability of modern instrumentation to analyze extremely small quantities of material. However, NMR remains problematical in this respect since the Fourier Transform (FT) NMR instruments necessary are often not available to second year undergraduate students. Current microscale organic texts do not routinely employ NMR for the analysis of student products because the experiments do not yield enough material to analyze in a timely manner. Even though NMR is now a major topic in sophomore and advanced undergraduate organic chemistry lecture courses, NMR theory taught in lecture cannot replace the learning of physically operating an NMR instrument and having to interpret experimental data. Our efforts in this area have resulted in a semester project in which students collect hands-on data on off-the-shelf compounds and then present the data in one of two ways: correlation table or spectral interpretation. By spreading the project over the entire semester we are able to minimize any large time commitment by the student or instructor and we are still able to retain all of our previous laboratory experiments. A description of the project, sample correlation tables and results will be presented as well as a discussion of pros and cons.

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MICROSCALE LABORATORY ON A SHOESTRING BUDGET. J. A. Landgrebe, Department of Chemistry, University of Kansas, Lawrence, KS 66045

Organic laboratories in large universities often have a considerable investment in a variety of microscale equipment. With a modest capital investment in automatic pipets and suitable top loader balances, good quality microscale laboratory work can be easily accomplished with a combination of semi-micro apparatus together with some innovative use of inexpensive Pasteur pipets and ordinary vials with Teflon liners in the caps. There is no need to purchase expensive kits. Detailed information about the techniques, costs, special practice experiments to prepare students for handling small quantities, and some new experiments will be made available.

170 A VERSATILE NEW MICROSCALE GLASSWARE COMPONENT.
Ronald Starkey, Chemistry
University of Wisconsin-Green Bay, Green Bay, WI 54311

Presently available components for organic microscale glassware are not well suited for introduction or removal of gaseous materials. I have found the custom component shown in Figure 1 to a valuable addition to a microscale glassware kit. This new part is better suited than a Claisen head for the attachment of gas supply balloons, and is useful for the attachment of hoses for the removal of noxious gasses from reactions. It provides an easy means to attach a thermometer to a system that must be open to the atmosphere, serves well as a vacuum attachment for reduced pressure work, and as ready means of purging systems with an inert gas. Applications of this new glassware component will be illustrated.

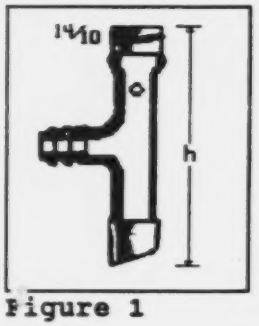

Figure 1

171 MICROSCALE VACUUM DISTILLATION. Donald L. Pavia, Gary M. Lampman, and George S. Kriz, Department of Chemistry, Western Washington University, Bellingham, Washington 98225; and Randall G. Engel, Green River Community College, Auburn, Washington 98002.

The use of vacuum distillation in the microscale organic laboratory will be described. The Friedel-Crafts acylation of a series of aromatic hydrocarbons yields products which are purified by vacuum distillation or other techniques. Infrared and proton and carbon NMR spectroscopies are used to characterize the products.

172 MICROSCALE ORGANIC LABORATORY EXPERIMENTS, Gerald W. Rausch, Department of Chemistry, University of Wisconsin, La Crosse, Wisconsin, 54601.

1) SYNTHESIS OF TRYPTICENE

Trypticene is produced by the anhydrous diazotization of anthranillic acid in solution with anthracene and n-butyl nitrite. The reaction is carried out in 19/20 ℥ glassware for the necessarily dilute solution. The resulting solid product is isolated and purified using microscale equipment. Yields of crude product are 50-70%.

2) N-ISOPROPYLANILINE BY REDUCTIVE AMINATION

The reductive amination of a ketone is conveniently carried out by treatment of an ethanol solution of aniline and acetone with sodium borohydride. The reaction, isolation, and purification by distillation is done with ACE microscale equipment. The yield of pure product is about 40%.

3) HYDROXYMERCURATION-REDUCTION OF 1-HEXENE

2-hexanol is produced by the classic hydroxymercuration of 1-hexene followed by reduction with sodium borohydride. The entire procedure is done with microscale glassware and yields in excess of 80% are normal.

173 AROMATIC POLYOLS FROM RECLAIMED POLYETHYLENE TEREPHTHALATE: A POLYMER RECYCLING EXPERIMENT. Dale Teeters and Paige Johnson, Department of Chemistry, The University of Tulsa, Tulsa, OK 74104.

Recycling of plastics is becoming a more important part of our society. Yet there are few polymer experiments that introduce this concept to science and engineering students. This paper is concerned with the formation of aromatic polyols from polyethylene terephthalate (PET) reclaimed from beverage bottles. PET can be converted to low-molecular-weight polyols by catalytic reaction with a free glycol. During this glycolysis reaction some of the free glycol replaces ethylene glycol from the PET chain by a process of chain scission and glycol exchange. This reversible reaction is continued until a chemical equilibrium is reached between the free glycol and the glycol from the polymer molecule. At equilibrium the PET polymer has been reduced to short-chain polyols that can then be used in other polymeric systems. This experiment serves as a good example of the chemistry that can be involved in recycling processes.

174 A MICROSCALE BENZENE-TOLUENE COMPETITION EXPERIMENT. R. A. Berry and C. E. Cain, Department of Chemistry, Millsaps College, Jackson, MS 39210.

During the past few years most chemistry departments, including ours, have eliminated benzene and other such chemicals from their teaching laboratories. As much as benzene is discussed in textbooks, we feel that it is important that the student encounter this compound at least once in the basic laboratory. We further feel that the student should learn how to properly handle and use chemicals that present a hazard. Microscale techniques readily lend themselves to such teaching. By the use of microscale techniques we have modified an old experiment so that the student can use benzene, toluene, and bromine without harmful exposure to the compounds. The experiment is a benzene-toluene competition for a limited quantity of bromine. The reaction mixture is analyzed by GC to identify and quantify the products of the competitive reactions.

175 PRINCIPLES OF NUCLEAR FISSION.* G. Friedlander, Brookhaven National Laboratory, Upton, New York 11973.

After a brief historical introduction, placing the 1938 discovery of fission in the context of what was then known of nuclear reactions, the basic phenomenology of fission will be reviewed. Topics covered will include: total energy release; fission cross sections; mass, charge, and kinetic energy split among fission fragments; fission product decay chains; prompt and delayed neutron emission; spontaneous fission; fission barriers. The key role of chemists and chemistry in fission research will be emphasized.

* Research carried out under contract DE-AC02-76CH00016 with the U.S. Department of Energy.

176 THE CHEMISTRY OF PLUTONIUM. Gregory R. Choppin, Department of Chemistry, Florida State University, Tallahassee, FL 32306

Plutonium is probably one of the best recognized chemical names and usually invokes images of destruction and harm. This is unfortunate as it is destined to play a major role in supplying the energy of the future. It also has a uniquely diverse and rich chemistry and offers unusual opportunities to chemistry teachers to illustrate a broad range of chemical properties. The metal can exist in six different allotropic states; the difference between the melting point and the boiling point is unusually great. Plutonium can exist in 6 different oxidation states: 0, III, IV, V, VI, VII. In fact, it can have the III, IV, V and VI states present simultaneously in aqueous solution. Each oxidation state has its own characteristic spectroscopic and chemical behavior, giving Pu an unusually rich redox chemistry. The interaction with anions for all the oxidation states is strongly ionic and their different behavior reflects the effects of the cationic charge density. These and other aspect of the chemistry of plutonium will be discussed to show how the unique diversity in its chemistry can be of value to teachers to illustrate many chemical principles.

177 PRESENT AND FUTURE NUCLEAR REACTORS. W. F. Miller, Jr., Los Alamos National Laboratory, Los Alamos, NM 87545.

Power plants, based on the principle of nuclear fission, provide a substantial fraction of the world's electrical power. Approximately 400 nuclear power plants operate in most of the industrialized world with 112 of these plants providing almost 20% of the United States' electricity supply. The basic scientific and engineering principles by which these plants operate are quite straight forward. However, owing to the large quantities of energy embedded in the core of the nuclear reactor, and the potential of the associated chemicals to do harm if inadvertently released, much care must be taken in designing effective engineered safety systems. These systems make existing plants quite complex. This complexity, as well as certain institutional problems, has resulted in a slow down in the world-wide deployment of nuclear power. Owing to the possible reductions in these institutional barriers and attractiveness of advanced reactor designs, nuclear power is poised for a new growth period. In the more distant future, so-called breeder reactors, that generate their own fuel, as well as nuclear fusion reactors, provide a hope of virtually limitless electrical power.

178 NATURAL NUCLEAR REACTORS--THE OKLO PHENOMENON. G. A. Cowan, Los Alamos National Laboratory, Los Alamos, New Mexico, 87545

In September 1972 scientists of the French Commissariat a l'Energie Atomique (CEA) announced discovery of an ancient fission reactor in the Republic of Gabon on the western equatorial coast of Africa. The reactor includes a string of several neighboring zones which achieved sustained fission separately. It is the first and, to date, the only known example of a fission reactor in nature. The reactor began to operate during the formation of a rich deposit of uranium nearly two billion years ago and continued at a very lowpower level of 10-100 kilowatts, enough to light a few hundred light bulbs, over a period of several hundred thousand years. The energy generated, around 15,000 megawatt-years, would meet the needs of a modern large city for about a decade. The fossil reactor was almost intact within a uranium vein uncovered in 1970 during open-pit mining operations at Oklo in the southeastern corner of Gabon. The relevance of the Oklo reactor to current research on the mobility of wastes placed in geological repositories is discussed.

179 OPTIONS FOR NUCLEAR WASTE DISPOSAL, Patricia A. Baisden, Nuclear Chemistry Division, L-234, Lawrence Livermore National Laboratory, P. O. Box 808, Livermore, CA 94550

A major concern associated with commercial nuclear power is the disposal of the radioactive wastes resulting from the operation of nuclear power plants. The technical issues involve the isolation of radioactive materials from the biosphere for perhaps hundreds of thousands of years. Thus the chemical and geochemical problems of nuclear waste disposal are both complex and challenging. Beyond the technical issues are social issues related to acceptable levels of social risk and the possible hazards of these radioactive wastes to future generations. This talk will provide illustrations of the practical applications of basic chemical principles taught at the high school and beginning college level to the solution of these complex problems. Some discussion of the long term risk associated with the various disposal options will also be given.

180 APPLICATIONS OF THE POLARIZED LIGHT MICROSCOPE IN THE PHARMACEUTICAL INDUSTRY. Scott Aldrich, Upjohn Company, 7000 Portage Road/4823-259-12

An acknowledged field for application of polarized light microscopy (PLM) is in pharmaceutical drug research, development, production and quality control. The efficacy of a drug depends on its chemical composition but also on its final dosage form, its physical state (crystal form, degree of hydration, etc.) crystal size and shape, presence of selected additives, and the absence of impurities. PLM techniques are an ideal way to monitor these properties and to relate them to drug efficacy.

181 APPLICATION OF THE POLARIZED LIGHT MICROSCOPE TO ASBESTOS IDENTIFICATION. John Henderson, Henderson/Longfellow Associates, Kennesaw, GA 30144.

One area in which polarized light microscopy (PLM) has no peer is in the examination of potential asbestos-containing materials. The microscopist must determine by particle shape if any components, present in amounts greater than one part per thousand, are fibrous. If so, we must identify them as asbestos or non-asbestos. If asbestos, which one: chrysotilel, tremolite, anthophyllite, actinolite, amosite, or crocidolite? If non-asbestos but fibrous, which one or ones: talc, nemalite, wollastonite, mineral wool, ceramic wool, fiber glass, hair, manmade or natural fibers, etc. The favored PLM technique, used worldwide, is called dispersion staining (DS). It is based on the optical properties of the fibers and requires addition of an 18 mm diameter glass disc (coverglass) with a 4 mm diameter spot of india ink inserted in the PLM objective. the shape, size, DS colors and other quick observations with the PLM, very rapidly and very confidently, identify not only asbestos and non-asbestos fibers but other extraneous materials such as gypsum or lime binder, diatomaceous earth, perlite, quartz, vermiculite and the micas.

182 APPLICATION OF POLARIZED LIGHT MICROSCOPY TO PRODUCT IDENTIFICATION. Thom Hopen, McCrone Environmental Services, Inc., 1412 Oakbrook Drive/Suite 100, Norcross, GA 30093.

In this day of extravagantly magnanimous court awards of damages in many civil lawsuits, there is a rush to protective measures when faced as defendant in such suits. Can you prove that rope that broke, or that substandard steel, paint, drug, plastic part, etc., was not even your product? Many companies protect themselves with trace components as tags. An unusual fiber or two incorporated in that rope or a few unusual pigment particles in that paint will identify a given company's product. (A few unusual fibers in a ten dollar bill are another good example). The absence of that trace component is a good defense against prosecution. Other defenses include specific and unusual formulations, both in composition and quantity that characterize a particular manufacturer's product. PLM is the usual method for monitoring production of such protected materials and for proving one's case in court. A major area for the application of PLM in product identification today is in proving the asbestos insulation in that building that now will cost $5,000,000 to remove is not your product.

183 APPLICATION OF POLARIZED LIGHT MICROSCOPY TO ARCHAEOLOGY. Donna Mefford, D C M Science Laboratories, Union, CO 80228.

Archaeology can be a very complex field for the application of polarized light microscopy. The information gained can, however, tell us a great deal about our ancestors" lives. How and when they lived, what they ate, what they wore, the materials they used for cooking, hunting, warfare or for protection from the elements, their art, body adornment, religion, trade with other communities, their diseases and infirmities, etc., etc. Most of these materials are found in advanced stages of decomposition and many are tiny bits requiring PLM. Bits of clothing, sandals, blankets, etc., can often still be identified as to plant or animal species. food residues sometimes remain in pottery. Pottery, stone tools and some building materials are probably the most durable of archeological artifacts. Thin sections of ceramics yield composition and sources of the components if viewed by PLM in crossection. Fibers and hairs, sees, feathers, jewelry, cosmetics, and other particulate substances readily yield their secrets to PLM.

184 APPLICATION OF POLARIZED LIGHT MICROSCOPY TO ART AUTHENTICATION. Walter C. McCrone, McCrone Research Institute, Chicago, IL 60616-33292.

With paintings, even of some 20th century artists, selling for millions of dollars many very talented artists are tempted to change their names to Rembrandt, Raphael, Manet or even Picasso and Warhol. The result is the presence in the art world of a large and rapidly increasing supply of art forgeries. These are then offered for sale as authentic paintings of a particular artist. Almost the only way to detect these threats to the integrity of the art world is PLM. A painting is a composition of support, paint medium and pigments. Many of these components have dates of "first use>" Any painting incorporating such a substance cannot have been painted before that date. Woodpulp paper is a post-1850 product, titanium white pigment post-1920 acrylic paints post-1930s, etc. All such components are identifiable by PLM. Obviously, however, most such samples, especially of paint layers for study, must be very tiny. The trained microscopist is able to remove the necessary tiny samples, leaving no detectable marks; identify the components; refer to their dates of first use and conclude that painting cannot have been created by the artist to whom it is attributed or that it may have been. He can, unfortunately, never conclude any painting is authentic (unless he saw it painted and added a distinctive, non-removable mark only he can recognize later).

185 USING ARTIFICIAL INTELLIGENCE TO PREDICT INORGANIC REACTIVITY. James P. Birk, Department of Chemistry, Arizona State University, Tempe, AZ 85287-1604.

An expert system has been developed, using Prolog, to predict products of inorganic chemical reactions. The expert system was designed to model predictive approaches used by a number of chemists, using the simplest rules possible, so the program can be used to help teach descriptive inorganic chemistry.

After one or two reactant formulas are input, they are parsed to determine the component elements, to recognize any significant polyatomic groups, and to assign oxidation numbers to the elements. This information, combined with a limited database, is used to place the reactants into classifications which will fire rules for various kinds of chemical reactions.

The expert system can describe the rules it uses to predict reaction products, so it has some tutoring capabilities. The expert system also provides access to the various databases that it uses, so it can also be used to a limited extent as a database program.

186 MOLECULAR ORBITALS MADE FRIENDLY - A NON-MATHEMATICAL, NON-GROUP THEORETICAL PICTORIAL APPROACH. John G. Verkade, Department of Chemistry, Iowa State University, Ames, Iowa 50011.

Undergraduate chemistry majors generally find it difficult to formulate MO schemes, especially delocalized ones, for molecules more complicated than diatoms. The major reason for this unfortunate situation is the general impracticability of teaching group theory before students take organic and inorganic chemistry courses where applications of these concepts are most beneficial. Consequently many students graduate with the impression that the ground rules governing bonding in molecules such as ammonia are somehow different from those which apply to aromatic systems such as benzene.

The principal tool used in our new teaching approach stems from the idea that MO's whether of the localized or delocalized variety, can be easily pictorialized from an extension of the geometrical characteristics of atomic orbitals. This tool can also easily be used to pictorialize normal vibrational modes for molecules.

187 **USING BIOGRAPHIES IN INORGANIC CHEMISTRY.** **D.C. Finster, Department of Chemistry, Wittenberg University, Springfield, OH 45501**

Biographies of 19th and 20th centuries chemists can be used as a vehicle to help students understand the historical, personal and political frameworks within which chemists have worked. This permits students to better understand that chemistry is a growing and changing field (as opposed to a static body of knowledge) and that chemistry, like all science, has developed within a cultural context and is not aloof from the rest of human activity. A classroom strategy for accomplishing these goals involving student reports goals will be described.

188 AN INTERCONNECTED NETWORK OF IDEAS FOR UNDERSTANDING THE PERIODIC TABLE, Glen E. Rodgers, Department of Chemistry, Allegheny College, Meadville, PA 16335

A network of ideas including (1) the periodic law, (2) the "uniqueness principle," (3) the diagonal effect, (4) the inert pair effect, (5) the metal/non-metal line, (6) the acid/base character of oxides, and (7) standard reduction potentials will be described. These ideas form an organizational framework that the presenter has found to be an effective way for students to make sense out of the descriptive inorganic chemistry of the representative elements.

189 MICROSCALE INORGANIC LABORATORY AT THE SOPHOMORE LEVEL. Zvi Szafran; Ronald M. Pike; Mono M. Singh. Chemistry Dept., Merrimack College, North Andover, MA 01845

A sophomore-level inorganic chemistry laboratory at the microscale level has been developed and offered at Merrimack College since 1986. The microscale level allows for a broader exposure to inorganic reactions than could previously be offered in a conventional semi-micro setting. Problems that have been overcome include high costs of chemicals, toxicity effects, safety aspects and waste disposal concerns. This paper will discuss several innovative experiments in the areas of main group, transition metal and bioinorganic chemistry. Development of microscale experiments has culminated in the writing of a comprehensive laboratory manual, available by summer, 1990.

Other aspects of conversion to a microscale program will be discussed.

190 THE ROLE OF THE LABORATORY COMPONENT IN ADVANCED INORGANIC CHEMISTRY. Gregory J. Grant, Department of Chemistry, The University of Tennessee at Chattanooga, Chattanooga, Tennessee 37403.

The role of the laboratory component in the advanced inorganic chemistry course will be discussed. The paper will address the issue of the balance between principles oriented experiments and synthetic experiments. Experiments used in the advanced inorganic laboratory at the University of Tennessee at Chattanooga will be presented. Topics covered in the principles oriented experiments include oxidation-reduction, solid state chemistry, kinetics, and point groups. In addition, a novel experiment which involves the synthesis of transition metal complexes containing the tridentate thioether, 1,4,7-trithiacyclononane, will be introduced.

191 Advanced Inorganic Chemistry at California State University, Sacramento, Londa Borer, California State University, Sacramento, 6000 J Street, Sacramento, California 95819.

For the past four years we have conducted a lecture-laboratory course at the senior level in inorganic chemistry. One of the requirements is three weeks of laboratory work to prepare and characterize a known compound for a poster session. For the lecture portion of the course, the students are required to give a 10 minute presentation on the library search of the same compound. Many students find this part of the course most beneficial and many students go on to do senior research in inorganic chemistry.

Course design, topics covered, experiments required, etc. will be discussed.

192 DISCUSSION-DEMONSTRATION LABORATORY EXPERIMENTS IN A LECTURE-ONLY DESCRIPTIVE INORGANIC CLASS. Gary P. Wulfsberg, Department of Chemistry, Middle Tennessee State University, Murfreesboro, TN 37132

We describe experiments in which students systematically investigate periodic trends in inorganic reactivity and discover for themselves some of these trends and design experiments to uncover these trends. Such "learning- cycle" experiments are in the authors' text, "Principles of Descriptive Inorganic Chemistry" (Brooks-Cole), and are remembered favorably years afterwards. Since our current course has no laboratory, we have devised a classroom modification called "Publish or Perish". The experiment is done as a demonstration, and teams of students compete to be the first research group to announce their discovery of a reactivity trend; their scientific peers (classmates) may then challenge their results. Later the teams may compete to design the best controlled experiment to investigate another reactivity trend. Although these demonstration-discussions are not as satisfactory as having the students perform the experiments themselves, they are attractive additions to a lecture-only course in which students would otherwise neither observe inorganic reactions nor think creatively about the periodicity that lies behind them.

193 GRAPHIC COMPUTER ANIMATIONS ON THE APPLE IIGS FOR LECTURES

Larry M. Julien, Dept. of Chemistry/Chem. Eng., Michigan Technological University, Houghton, Michigan 49931

This presentation will show samples of animations that are used in the lectures at Michigan Technological University. These animations are used to describe concepts and phenomena that are difficult for students to grasp and understand. They provide a model for remembering.

194 GRAPHICS IN A FULL COURSE COMPUTER CURRICULUM IN GEN. CHEMISTRY.

James D. Spain, Dept. of Chemistry, Clemson University, SC 39634

Clemson is in the third year of a program that integrates required CAI into a freshman chemistry course involving over 1600 students. Students are given weekly assignments of computer programs which reinforce and amplify material covered in lectures. The learning center employs about 40 IBM-PC computers, and is open approximately 13 hours each day during the week. Initially, programs by Butler (U of M) were employed exclusively. However, these have been replaced with programs that we have developed specifically for required use. The programs are essentially tutorials which drill the students on the basic knowledge and problem solving skills that they are expected to know to pass the course. Graphics is used to enhance the learning environment and illustrate difficult chemical concepts. The emphasis is on providing individual graphical explanations to personalized problems posed by the computer, units cancellation during dimensional analysis, orbital box diagrams of electron configuration, chemical formulas and equations which realistic subscripts and graphing data in various formats.

195 ANIMATED SIMULATIONS AND DEMONSTRATIONS FOR CHEMISTRY LECTURE CLASSES

P. I. Pavlik, Dept. of Chemistry, Northern Michigan University, Marquette, Michigan 49855

The author has developed a large collection of programming tools to enable programming of computer animations of chemically relevant events in TURBO Pascal 4.0 (and later versions) on IBM PC's or compatible microcomputers. Both "real time" and "page flipping" techniques are included in this package of procedures.

This presentation will show numerous projective, three dimensional animations suitable for use as demonstrations in high school and college chemistry lecture classes. The demonstrations presented here will include such events of chemical interest as the autodissociation of water molecules, SN1 and SN2 organic reaction mechanisms, surface reaction catalysis, crystal formation and structure, time dependent wave mechanical phenomena, atomic structure and spectra, and atomic mass spectrometry.

196 COMPUTER GRAPHICS DISPLAY OF MOLECULAR ORBITALS. R. H. Batt, Dept. of Chemistry, Kenyon College, Gambier, Ohio 43022

Currently enjoying rapid development is the use of computer graphics to assist understanding the copious numerical output from complex computer models in fields such as astrophysics, fluid dynamics and computational chemistry. This presentation will describe a package of IBM PC compatible software, presently under development, for the computation and graphical display of molecular orbitals computed at the Huckel, Extended Huckel and CINDO levels of approximation. The MOs are displayed in perspective projection as three dimensional "wire mesh" contour surfaces with hidden lines removed. Several examples of using this package in the teaching of physical, organic and inorganic chemistry will be presented.

197 INTERACTIVE COMPUTER GRAPHICS: VISUALIZATION METHODS FOR MODELLING COMPLEX MOLECULAR SYSTEMS, W. J. Howe, Computational Chemistry, The Upjohn Company, Kalamazoo, Michigan 49001

Over the past decade, dramatic increases in the speed and power of graphics devices and computers have enabled scientists to manipulate much more sophisticated graphical representations than the traditional "wireframe" molecular models. One of the driving forces behind the development of novel graphical representations has been the need to simplify complex structural data, especially in large, complicated molecules such as proteins. This presentation discusses a number of current research problems to illustrate how the selection of proper graphical representations can aid in scientific understanding. Topics include molecular surface representations and projections, graphical simplification of large data sets in protein homology modelling, the "autodocking" of large numbers of amino acid probes into enzyme clefts as an aid to inhibitor design, and the appropriate use of color as a fourth dimension on a 3-D device.

198 ENVIRONMENTAL PANEL. C. S. Kiang, School of Earth and Atmospheric Sciences, Georgia Tech, Atlanta, GA 30332

Members of the faculty and staff at Georgia Tech will first review the scientific basis of global environmental issues. Global and regional air quality and global warming will be addressed by D. M. Cunnold. F. M. Saunders will discuss water pollution and reclamation in the next decade, and J. Nemeth will review indoor air pollution problems and discuss the teaching of chemistry from an environmental perspective. An open discussion period will follow in which the topics will include public policy issues and the socioeconomic impacts associated with environmental problems, and the need for a strong educational component in order to solve these problems.

199 SYMPOSIUM: General Chemistry Textbook Authors and Editors Meet Their Public. Conrad Stanitski, Department of Chemistry, Mount Union College, Alliance, OH 44601

In many institutions, the first year's chemistry program is guided by, if not dictated by, the choice of textbook. Thus, the availability and nature of general chemistry texthooks are major elements to the success of the general chemistry program. This symposium is an opportunity for those using these major texts to raise questions about the coverage, format, and appropriateness of such texts. A panel consisting of the authors and editors of best-selling general chemistry texts will present comments about the writing and production of their books. Panelists will also respond to specific questions directed to them by the symposium director and from the audience.

The symposium format will allow audience members to hear from the panelists and to respond to their statements, in lively exchanges of ideas. To encourage continued conversations among panelists and participants, a sponsored reception will be held immediately following the symposium.

200 THE MICROSCALE ORGANIC CHEMISTRY LABORATORY, AN INTRODUCTION. Charles E. Sundin, Department of Chemistry, University of Wisconsin-Platteville, One University Plaza, Platteville, WI 53818-3099.

The microscale approach to the sophomore organic laboratory has mushroomed in the past eight years. Mayo, Pike, and Butcher's ground breaking laboratory text Microscale Organic Laboratory is in its second edition and some four other texts are now in print. The discussion will review the basic microscale organic laboratory and its advantages as well as the author's experiences with the Mayo, Pike, and Butcher texts.

201 CONTINUING DEVELOPMENTS IN MICROSCALE ORGANIC LABORATORY. Donald L. Pavia, Gary M. Lampman, and George S. Kriz, Department of Chemistry, Western Washington University, Bellingham, Washington 98225; and Randall G. Engel, Green River Community College, Auburn, Washington 98002.

The development of new experiments for a microscale organic laboratory program will be described. Experience with the testing of experiments and the use of new microscale apparatus will also be discussed.

202 CONVERSION OF A LABORATORY PROGRAM TO MICROSCALE. John H. Penn, Institute for Microscale Chemistry, Department of Chemistry, West Virginia University, Morgantown, WV 26506.

The conversion of the organic laboratory from macroscale experiments to microscale experiments can be a frightening experience, even with extensive planning. This talk will present a number of issues which were confronted in the conversion of a state university organic laboratory program from macro- to microscale. These issues include monetary requirements for conversion, required equipment, and the curricula of experiments for the laboratory experience. The solutions utilized at West Virginia to these conversion issues will be discussed, together with an assessment of the success of these solutions.

203 INTRODUCING MICROSCALE EXPERIMENTATION AT A LARGE UNIVERSITY. NEW EXPERIMENTS AND APPARATUS. Kenneth L. Williamson, Department of Chemistry, Mount Holyoke College, South Hadley, MA 01075.

Small colleges have been the leaders in the introduction of microscale techniques to the organic chemistry laboratory. The same professor often gives the lectures and runs the lab. He or she is willing to take the time to learn the new techniques and pass this information directly to the students. At a large research-oriented university the professor giving the lectures may have little or nothing to do with the lab. The person in charge of the lab, often not a faculty member, is in charge of a number of graduate students who usually do not know anything about microscale experimentation, and who, with the best of intentions, can mislead undergraduates carrying out experiments. It is a tribute to these laboratory directors that microscale experimentation is ever introduced in a large university. An exposition of the problems they have and their possible solutions will be presented. In addition some new microscale apparatus and experiments (e.g. the recycling of a plastic bottle) will be discussed.

204 **NEW DIRECTIONS IN LABORATORY DESIGN FOR MICRO-SCALE LABORATORIES.** Graye J. Shaw and George H. Wahl, Jr., Department of Chemistry, North Carolina State University, Raleigh, NC 27695-8204.

The "Micro-Scale" revolution was spawned at Bowdoin College in response to concerns for a safer environment for the instructional laboratory. The reduction in scale that resulted is now a bright part of the history of chemical education. This new scale of work presents very different requirements for a working environ-ment. We are designing a new laboratory and simultaneously developing plans for an expected modernization of other laboratories. We will discuss our planning process and our new set of facility requirements for instructional laboratories. Why must students stand? What are the real ventilation requirements for a "Micro-Scale" laboratory? Must all experience with expensive instrumentation be "hands-on"?

205 A MICROSCALE LABORATORY FOR FRESHMEN BASED ON THE SOLVING OF INDIVIDUAL PROBLEMS. Seyhan N. Ege, Department of Chemistry, University of Michigan, Ann Arbor, MI 48109-1055.

In the Fall Term 1989 the Department of Chemistry at the University of Michigan inaugurated a new curriculum. This curriculum introduces students with a solid high school background in chemistry to the major concepts of chemistry in the context of organic chemistry. A new approach to laboratory work was also developed at the same time. Students were given their own problems, mainly involving separation of a simple mixture and identification of its components, to solve. They worked mostly on the microscale with emphasis on thin layer chromatography and FT-IR spectroscopy as methods for following separations and reactions. The philosophy behind this approach and the reaction of students to it will be discussed.

206 STANDARD AND MICROSCALE ORGANIC CHEMISTRY EXPERIMENTS. Oscar R. Rodig, Department of Chemistry, University of Virginia, Charlottesville, VA 22901; Charles E. Bell, Jr., and Allen K. Clark, Department of Chemical Sciences, Old Dominion University, Norfolk, VA 23529.

In recent years, there has been a growing tendency to carry out elementary organic laboratory experiments on a "micro" scale using milligram quantities rather than grams. Many instructors feel that a well-rounded course in elementary organic laboratory principles, should also include "macro" sized experiments since techniques used in these are often quite different from those using micro quantities. At times, the micro scale amounts indicated in Rodig, Bell, and Clark may be slightly larger than those described by others, but our experiences have shown that the additional savings in chemical costs do not warrant the very small amounts. Readily available standard laboratory equipment, such as the centrifuge, Pasteur pipet, Hirsch funnel, septum, syringe, and ordinary small-scale glassware may be used, thus eliminating the need for specialized apparatus or micro kits. To enhance student preparation for laboratory sessions, "Pre-Lab" questions for each experiment are recommended. Several categories of experiments will be discussed.

207 A COMPARISON BETWEEN MICROSCALE TECHNIQUES. María A. Aponte, Department of Chemistry, University of Puerto Rico, Mayagüez Campus, Box 5000, Mayagüez, PR 00709.

Modification of laboratory glassware for experiments done at microscale has been done, for example, by Dana Mayo and Kenneth Williamson. In order to compare both approaches, a course on microscale techniques was offered at UPR-Mayagüez. In it, the participants were introduced to microscale by carrying out experiments in which basic techniques were practiced and reactions done alternating the use of two different kits. The results on the comparison performed and suggestions on how to implement the technique will be presented.

This work was sponsored by: Resource Center for Science and Engineering (UPR), Center for Faculty Development (UPR) and the Department of Education (MSIP).

208 CULTURAL DIVERSITY IN THE CHEMISTRY CURRICULUM. Catherine Middlecamp, Chemistry Tutorial Program, University of Wisconsin-Madison, Madison, WI 53706

Science and math courses tend to be viewed as "culture free", offering little opportunity to teach material related to minority issues or perspectives. While this can be the case, it need not be. In fact, it is perhaps a far more difficult task to teach a course that does not relate cultural issues and concerns than to teach one that does.

In chemistry courses, a cultural bias can enter the classroom either directly (e.g. by content presented or by contact with students) or indirectly (e.g. by omission or by implication). In this presentation, factors such as these will be addressed, drawing on the author's experience in directing the Chemistry Tutorial Program for Minority/Disadvantaged students as well as from personal experience teaching at the college level. Practical suggestions about making courses more inclusive to traditionally underrepresented groups of students will be offered.

209 TEACHING CHEMISTRY TO ASIAN-AMERICAN STUDENTS
Agnes Lee and Catherine Middlecamp, Department of Chemistry
University of Wisconsin-Madison, WI 53706

Asian Americans have been stereotyped as the "model minority", that is, intelligent, hard-working, and successful against all odds. However, this stereotype not only may impose unfair expectations on "good" Asian students, but also may overlook those students who are in need of assistance, denying them sorely needed help.

Data taken from general chemistry courses at the University of Wisconsin-Madison will be used to illustrate several points about the issues involved. It is hoped that the talk will give educators an awareness of the diversity among Asian-ethnic students, their needs, and some of the resources to meet those needs. Practical teaching suggestions and an annotated list of references will be provided.

210 FINDING SOME POWERFUL WAYS TO REACH MINORITY AND FEMALE STUDENTS. Elizabeth Kean, 27 Henzlik Hall, University of Nebraska-Lincoln, Lincoln, NE 68588-0355.

Minority and female students continue disproportionally to reject science as a career option. They seem to find little use or interest in what science teachers have to offer. To increase their participation and success in science, we must change what and how we teach, and how we interact with students from diverse cultures.

During the past two summers, science teachers and administrators from the Omaha (Nebraska) Public Schools have met to explore strategies for improving science teaching for minority students. Month-long workshops brought together three powerful themes: 1) understanding the strengths and needs of minority students; 2) cooperative learning; 3) content selection based on problem solving. Participants developed new instructional units using these themes. In this presentation, sample lessons and videotapes will be used to convey the substance and spirit of resulting changes in classroom activities. Preliminary evidence for teaching effectiveness will be presented.

211 YOUNG WOMEN AND CHEMISTRY AS A CAREER CHOICE. WHY NOT? Rita K. Hessley; Department of Chemistry, Western Kentucky University, Bowling Green, KY 42101.

A small survey, involving 18 schools, has been conducted among a group of high school chemistry teachers and high school chemistry students to discover reasons why young women reject chemistry as a career choice. While some outcomes and areas of agreement between the two groups were predictable, some interesting differences in opinion/impressions came to light. There is evidence that chemistry teachers may need to try to avoid or at least temper one of the repercussions of our stress on laboratory safety if we hope to attract more women to our ranks. A description of the survey, a survey of the responses and some remarks about women and chemistry as a career choice will be presented.

212 SOME SUGGESTIONS FOR TEACHING CHEMISTRY TO VISUALLY IMPAIRED STUDENTS. Harry E. Pence, Lorie Beers, and Michael Washburn, Department of Chemistry, SUNY Oneonta, Oneonta, NY 13820

The number of handicapped students who are deciding to pursue higher education is increasing significantly, and one of the largest groups of individuals in this category consists of those who are visually handicapped. These students have both a legal and a moral right to expect that colleges and universities will be ready to respond to their needs. Reasonable preparation and moderate flexibility can help to make chemistry courses not only more accessible for visually impaired students but also an excellent educational experience for both the student and the teacher. This presentation will make some specific and relatively straightforward suggestions regarding lecture, laboratory, and examination strategies that can contribute towards that goal.

213 INCREASING LEARNING IN THE LABORATORY FOR ALL STUDENTS...ESPECIALLY THOSE "AT RISK". Ronald J. Schwarz, Kirkwood High School, 601 West Essex, Kirkwood, MO 63122.

We have discovered that by utilizing one computer and student performance evaluative software students' interest, attitude, and self confidence can be dramatically increased. This approach has been used very successfully with the more motivated average and above average students. It has also proved to be extremely successful with the "At Risk" students in creating excitement for them.

The continued use and need for flexibility of a lab evaluator program by many different teachers led to the development of an "authoring" program named Lab Assistant™. Based on the needs and requirements that are specified by the teacher who is using the program. Lab Assistant™ instructs the computer to write free standing lab evaluator programs in BASIC language. The lab evaluator program which is written by Lab Assistant™ is designed to specifically meet the requirements for the lab that were prescribed by the teacher. The teacher using this program does not have to be a computer "whiz": he only needs to answer 18 questions about how he wants to evaluate the lab. Students not only are scored and given "on-screen" directions for improvement, they also view a graph and can see how their own data point fits in with the data points of other members of his/her class.

214 ADVISING CHEMISTRY STUDENTS ABOUT MEDICAL SCHOOL. D.M. Sullivan, Department of Chemistry, University of Nebraska at Omaha, Omaha, NE 68182.

Although some of the best chemistry students go on to become excellent physicians, teachers of chemistry often discourage students from considering careers in medicine. The result has been that many chemistry students have failed to gain acceptance to medical schools. We can help our students by providing accurate information about the professional world as we perceive it.

215 WHAT HAPPENS TO STUDENT PERFORMANCE WHEN THEIR CONTROL OVER CAI PROGRAMS IS MAXIMIZED? Michael P. Doherty, Department of Chemistry, East Stroudsberg State University, East Stroudsberg, PA, and George M. Bodner, Department of Chemistry, Purdue University, West Lafayette, IN.

Commonly stated advice to authors of CAI programs is to maximize student control over the program. Laurillard has claimed that the goal of individualizing instruction to satisfy the needs of a given student can only be achieved by giving students control over the sequencing of instructional programs. Johansen and Tennyson, however, have argued that students are often poor judges of their needs and Brown notes that students responsible for choosing their own path through CAI lessons have often been observed to wander purposelessly through the material. Students -- especially weaker or poorly motivated students -- make bad choices and learn less when they get to make too many choices. In this paper we will present the results of a study of what happens when student control over a program designed to teach molecular geometry was maximized.

216 WHAT HAPPENS TO PERFORMANCE WHEN STUDENTS DO NOT SPEND ENOUGH TIME PER PROBLEM IN CAI PROGRAMS? Michael P. Doherty, Department of Chemistry, East Stroudsberg State University, East Stroudsberg, PA, and George M. Bodner, Department of Chemistry, Purdue University, West Lafayette, IN.

A post-test design was used to evaluate the effectiveness of a CAI program on molecular geometry. An interesting result was obtained when performance on the test was correlated with the average amount of time students spent per problem while working the CAI program. Almost all of the post-test scores in the bottom half of the range were achieved by students who had spent less than one minute per problem, in spite of large differences in the number of problems these students worked and the average score on the post-test for students spending more than one minute per problem was significantly higher than the average score for those who spent less than one minute per problem. This paper will describe the results of this experiment and discuss implications for authors of computer-assisted instruction programs.

217 THE LAND OF OZONE. Dr. Patrick K. Monaghan, Dept. of Chemistry, Sir Wilfred Grenfell College, Memorial University of Newfoundland, Corner Brook, Newfoundland A2H 6P9

Protection of the Earth's Ozone Layer has become one of the most hotly debated environmental issues of our time. This paper will trace the origins of the debate through the 1970's. During this decade several sources of ozone depletion were targeted. The debate disappeared from the public forum at the end of the decade and was revitalized by the announcement (1985) of Joe Forman, Head of the British Antarctic Survey Team, of an "ozone hole" above the Antarctic. The paper will also discuss some of the proposed chemistry involved in ozone destruction and the new political initiatives directed at controlling the emissions of CFC's.

218 GENERAL CHEMISTRY "HELP" SESSIONS. Tim Goodman, Division of Arts and Sciences, Waycross College, Waycross, Georgia 31501.

At a small two-year college located in a somewhat isolated area, it is very difficult to find adequate tutoring in chemistry. A number of methods of tutoring have been tried, but the most effective seems to be what are called "help" sessions, optional review sessions led by the instructor and scattered throughout the quarter. The presentation on "help" sessions will focus on (1) the evolution of the "help" session, beginning as an aid to students not having high school chemistry and expanding to enjoy an average attendance of 86% of the enrolled students, (2) the general structure of the "help" sessions, meeting from 10 to 16 times per quarter, with sessions being driven by both student requests and instructor preparations, and (3) the "help" session as perceived by the instructor, students, and administration. Since beginning "help" sessions the overall student average in chemistry has increased from 70.2% to 77.6%, thereby increasing the average grade in chemistry. More significant is a reduction in the number of withdrawals, from 12.4% during the period before "help" sessions to 6.6% during the period after "help" sessions were begun.

219 THE ROLE OF POTENTIAL ENERGY IN CHEMISTRY. R. Thomas Myers, Kent State University, Kent, Ohio 44242.

Why do chemical reactions occur? For our beginning students, as a little white lie, we speak of filling octets. Or we mention negative enthalpy changes, but the students do not know what this "enthalpy" is, or why negative ΔH should be spontaneous. We can speak of negative free energy change, but this is more mysterious. However, students can understand decreases in potential energy, after they learn what P.E. is. First I demonstrate the first law, and in the process demonstrate and define potential energy. This is not stored energy, but energy due to relative position or configuration. Then follows the important corollary: when conditions are appropriate, P.E. will always decrease. Negative ΔH is due to a decrease in P.E. Now I introduce a simple version of the second law, but without using that term. (Finally, there is another factor, entropy, but this will be treated later, and in fact is not decisive in most cases.)

220

A PRIMER ON HAZARDOUS MATERIALS, CHEMICALS, AND WASTE

S. M. Wright, Chemistry Department, Univeristy of Wisconsin - Stevens Point, Stevens Point, Wisconsin 54481

Confused by the acronyms and jargon of laws regulating the transportation, use, and disposal of Hazardous Materials, Chemicals, and Wastes? So was I! This presentation will serve as a basic foundation from which an understanding of these terms can be built. General definitions of various terms will be discussed, to help answer the questions: who is regulating what; and how can I, as an instructor, begin to respond to these regulations?

221 A PICTORIAL TOUR THROUGH THE LIEBIG LABORATORY/MUSEUM, Norman W. Hunter, Western Kentucky University, Bowling Green, KY 42101.

This topic will be presented mainly through the use of 35mm colored slides. The viewer will be taken on a tour of the Laboratory/Museum, a former barracks and guardhouse, in Giessen, West Germany, where Justus von Liebig taught chemistry and carried out chemical research from 1824 to 1852. The primary focus will be on the life and contributions to chemistry of Justus von Liebig. Liebig's scientific achievements and his "professional family" will be reviewed. This outstanding chemist's scientific heirs include approximately 44 Nobel Laureates! The tour will include the original laboratory, in fact the only laboratory until 1834, and the additional rooms added in 1834 and 1839. Liebig's private laboratory, private office, library and auditorium will also be seen. Many pieces of laboratory equipment will be viewed, including a carbon dioxide liquifier, condensers and the famous elemental analysis apparatus with attached kaliapparat.

222 THE OZONE HOLE: MOTIVATION FOR CHEMICAL EDUCATION

Herb Bassow, Germantown Friends School, Philadelphia, PA 19144

The relevance and necessity of understanding chemistry is shown to be the essential component students must have to evaluate increasing worldwide concern about stratospheric ozone loss. A short history of the chlorofluorocarbon- ozone controversy and update of 1986-89 Antarctic ozone "hole" measurements leads to specific illustrations of this problem's unique character. These include its boundaryless worldwide nature, irreversible long-term effects that most impact as yet unborn children of today's students. This, in turn, illuminates the need for student understanding of catalysis, rate constants, the interrelationship between all areas of science, economics, political and societal concerns required to solve this very real problem.

223 BEYOND THE FRINGE: DA, STS AND SETI. Clifford Matthews, Department of Chemistry, University of Illinois at Chicago, Chicago, Illinois 60680

At three out-of-the-ordinary meetings this past year,

DA at the Crossroads, a national conference on the Doctor of Arts Degree concerned with re-assessing teaching and research priorities in all fields of college education, including chemistry;

Technological Literacy Conference 5, organized by the National Association for Science, Technology and Society, grappling with questions (many with a chemical background) for which there are no easy answers; and

Bioastronomy--the Exploration Broadens, the Third International Symposium on the Search for Extraterrestrial Life, demonstrating again that chemistry is the bridge between astronomy and biology,

one came away with the feeling that perennial problems of science education are being addressed at a new networking level that can only reinforce our efforts to add breadth and perspective to the specialized programs demanded of undergraduate and graduate majors in chemistry. Further, this new awareness can help us convey to students of the humanities and professional schools something of the excitement and significance of science as the shaping cultural activity of our time.

224 THE INSTRUCTIONAL VERSATILITIES OF MICROSCALE LABORATORY. Ning Huai Zhou, Hangzhou Teachers College, Hangzhou, 310012, People's Republic of China.

The microscale technique in general chemistry has been introduced into some universities in China since 1988. Besides safety and economy, other major advantages of microscale lab are the instructional versatilities. There are:

1. The idea of environmental protection would be established vividly in the mind of the student from it.
2. The student would show greater interest in microscale experiments: Conscientiousness becomes a way of life in the manipulations. They would do their best to learn the skill of microscale technique.
3. The student can finish more micro experiments than conventional ones in the same lab time. They can do those experiments which consume expensive chemicals.
4. The microscale technique urge the improvement of teaching methods. It will benefit chemical education in developing countries.

225 A SMALL-SCALE APPROACH TO GENERAL CHEMISTRY LABORATORY INSTRUCTION. Rosemary Fowler, Department of Chemistry. Cottey College, Nevada, Missouri 64772.

During the past three years we have integrated a variety of small-scale experiments into our one year course. Several new techniques and procedures, not common to general chemistry laboratory programs, have been implemented including the use of inexpensive solid aluminum heat blocks for heating solutions in qualitative analysis. Our presentation will describe these small-scale experiments, associated techniques and procedures, and the numerous advantages gained by incorporating small-scale experiments into our general chemistry program.

226 SIMPLE CELLS FOR POTENTIOMETRY. Howard P. Williams; Chemistry Department, Box 5043 Southern Station, University of Southern Mississippi, Hattiesburg, MS 39406

The need for versatile and rugged electrochemical cells for potentiometry in the teaching laboratory has led to many innovative designs over the years. A simple cell design which offers ruggedness, low cost and is easily cleaned has been developed using inexpensive plastic ware. Details of construction and typical experiment applications will be presented. Such applications include concentration effects on cell voltage, differential electrochemical titrations and comparison of various half cell voltages.

227 CRITICAL THINKING AND THE INTRODUCTORY LABORATORY Brian P. Coppola University of Michigan, Department of Chemistry, Ann Arbor, Michigan 48109-1055.

The use of microscale laboratory techniques has played an integral part in a comprehensive renovation of the undergraduate chemistry curriculum at the University of Michigan. The goal is to provide students with individualized and open-ended activities in order to instill a more expert sense of scientific practice. Laboratory textbooks are used as a resource for techniques. As assignments, students are given experimental goals to achieve, as contrasted with a cookbook procedure to follow. By not allowing students to defer authority to either textbooks or their labmates, they are impelled to more seriously engage in their own activities. The microscale format allows a more research-like paradigm to be successful, since repeating and modifying experiments is so practical. Examples of these experiments, the philosophy for their selection, and how first-year students have engaged in, and responded to these courses,are presented.

228 FACILITATION OF HIGH SCHOOL MICROSCALE LABORATORIES VIA A LABORATORY EQUIPMENT ASSISTANCE PROGRAM (LEAP). F. J. Dinan and J. F. Bieron, Department of Chemistry, Canisius College, Buffalo, NY 14208.

LEAP is an NSF sponsored program located at Canisius College. It provides high school chemistry classes with relatively sophisticated laboratory equipment and instrumentation, provides instruction in their theory and use, and supports the maintenance of these materials. By providing these materials, LEAP allows more interesting and challenging experiments to be done in the high school environment than would otherwise be possible. Incorporation of microscale equipment and techniques into the LEAP program facilitates their introduction into the high school environment. LEAP provides additional support for the use of microscale techniques at the high school level by providing microscale workshops and sponsoring meetings at which teachers can share ideas and experiences. This process supports the development of microscale experiments suitable for high school use.

229 SIGNIFICANT FIGURES IN MULTIPLICATION AND DIVISION. Clyde R. Metz, Department of Chemistry, College of Charleston, Charleston, SC 29424.

The usual rule for determining the number of significant figures to which the result of the multiplication or division of two factors should be expressed is based on the lesser number of significant figures present in the factors. An analysis of the random error propagation for these processes indicates that this rule is only 75% accurate for the product and 65% accurate for the quotient. A simple modification of this rule that includes the consideration of the relative values of both the factors and the result of the calculation is accurate to 95% and 85%, respectively.

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TEACHING INORGANIC NOMENCLATURE: A SYSTEMATIC APPROACH. *Gerhard Lind, Department of Chemistry, Metropolitan State College, Denver, CO 80204*

A semi-systematic scheme for naming inorganic ions and compounds is presented. The scheme is divided into three groups: cations, anions, and compounds. Each of the three main groups is further subdivided. A total of eleven subgroups is presented, each with rules, examples, and comments. The main task is to find the right subgroup for each species (cation, anion, compound). Once the subgroup is found, the naming is easy.

231

TEACHING HOW TO BALANCE REDOX EQUATIONS - A 10-STEP RECIPE. Gerhard Lind, Department of Chemistry, Metropolitan State College, Denver, CO 80204

An easy to follow step by step procedure for balancing redox equations is presented. The procedure uses the oxidation number change method and works for basic and acidic solutions. Both molecular and ionic equations can be balanced. There is nothing new about the procedure, but it is presented as a compact 10 step "recipe" which works for all redox equations.

The procedure presented can be used in the classroom or as a study guide for the students as well as an interactive computer tutorial program.

232 A LOW COST, SAFE, AND PORTABLE APPARATUS FOR LECTURE HALL CONDUCTIVITY DEMONSTRATION. Gary D. Mercer, Department of Chemistry, Boise State University, Boise, Idaho 83725.

The construction and operation of an apparatus for demonstrating conductivity of solutions suitable for lecture hall use will be discussed. The device features a "phone plug" cell and a square wave oscillator for reasonably stable and accurate conductivity measurements. The output is a three-step illuminated array of lights for differentiating between nonelectrolytes, very weak electrolytes, weak electrolytes and strong electrolytes. Operational amplifiers are used to generate the square wave signal and then as comparators for distinguishing between the types of electrolytes and driving the illuminated output. The device is battery operated and costs less than $25 to construct using readily obtainable components.

233 ENHANCEMENT OF GENERAL CHEMISTRY LABORATORY CURRICULUM THROUGH USE OF INEXPENSIVE DIGITAL pH-mV-TEMP METER; Charles J. Bier, Box 2377, Ferrum College, Ferrum, VA 24088

Having observed that students (ours and others') do not seem to have good quantitative skills for manipulation of experimental data after their general chemistry course, we have embarked on a program to upgrade our laboratory exercises in our general chemistry courses by more extensive use of quantitative measurement and analysis of changes. The relatively low cost of a digital meter and probes ($200) to measure hydronium ion concentration accurately to 0.1 pH unit and temperature accurately to 0.1 K unit led us to add this capability to our already accurate and efficient determination of mass (0.01g) and volume 0.05 ml. We are simultaneously moving toward semimicro and micro laboratory experiments to achieve the common goals of greater safety and lower materials and disposal costs. The goals of our development of experiments are low hazard, low cost, high relevance, coupling of qualitative and quantitative observations, and support of the pedagogical objectives of the classroom portion of the course. I will share experiments we have developed and solicit experiments developed by others.

234 AMMONIA MINI-FOUNTAIN. Dianne N. Epp, East High School, 1000 So. 70th, Lincoln, Nebraska, 68510

The solubility of ammonia gas in water has been a popular lecture demonstration in the form of an ammonia fountain. A variation on this, which allows each student to prepare a microscale version of the ammonia fountain using a plastic transfer pipet to contain the reaction, has proved effective as a follow-up laboratory exercise to the lecture demonstration. Preparation and experimental procedures will be covered in this presentation.

235 WRITING ACROSS THE CHEMISTRY CURRICULUM: ORGANIC CHEMISTRY. Francis M. Klein, Department of Chemistry, Creighton University, Omaha, Nebraska 68178-0104.

Despite persistent student opinions to the contrary, learning organic chemistry is not purely a matter of memorization of facts. To reinforce a broader image of the field and to encourage more integrative thinking about its concepts, the author has included mini-themes and essays among the course requirements. While some of these have been examination questions, the aims of the assignment are best served by out-of-class work. With out-of-class assignments students know what is expected of them and have the resources and the time to do a thorough job. Examples of the assignments and selected student responses will be presented. The grading of the assignments and the use of assignment graders in the course grade will be discussed.

236 INTEGRATED EXPERIMENT FOR GENERAL CHEMISTRY: PREPARATION AND ANALYSIS OF A COBALT COORDINATION COMPOUND. Dr. Anne T. Sherren, Department of Chemistry, North Central College, Naperville, IL 60566-7063.

This experiment involves the preparation of $[Co(NH_3)_5Cl]Cl_2$ in one three-hour experiment, and then the analysis in two additional three-hour laboratory periods. The students perform qualitative tests on the complex to prove the presence of cobalt ion, ammonia, and chloride ions. The ammonia is quantitatively determined by using a modified Kjeldahl method. The cobalt is quantitatively determined by treating the residue with acid and potassium iodide. The liberated iodine is determined by titration with thiosulfate. The chloride content is determined by difference. The students determine the number of free chloride ions by using cation ion exchange. After determining the percent composition, the students calculate the empirical formula and draw the structure of the complex compound. Positive feedback has been received from the students. This experiment reviews and inter-relates a number of concepts which have been covered earlier in the course.

237 IDIRICE: Moving Beyond the Aqueous Equilibria ICE Table. Edward A. Mottel, Department of Chemistry, Rose-Hulman Institute of Technology, Terre Haute, IN 47803-3999.

To solve simple aqueous equilibria problems in general chemistry many textbooks and teachers have used an ICE table, the "bookkeeping" technique to track Initial, Change and Equilibrium values for equilibrium calculations.

Problems which become more complicated due to the addition of a reactant or common ion often confuse students, who try to "force" all of these reagents into one template. A sequential process involving initial conditions, dissociation, reaction and equilibrium change (IDIRICE) has been developed which stresses electrolytic character and favorable reactions in addition to components of the traditional ICE table.

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SIMPLE AND INEXPENSIVE KINETICS: A STUDENT LABORATORY EXPERIMENT. David K. Erwin, Department of Chemistry, Rose-Hulman Institute of Technology, Terre Haute, IN 47803-3999.

Experiments involving chemical kinetics often employ elaborate equipment and chemicals. A simple and inexpensive setup involving plastic apparatus with hydrogen peroxide and potassium iodide can be used to obtain rates of reaction and the activation energy for the decomposition of hydrogen peroxide into water and oxygen. Data and results obtained, as well as the apparatus, will be presented.

239 THE ROLE OF VIDEO EQUIPMENT AND MICROSCOPY IN CHEMICAL EDUCATION. Tomas G. Berger and Stephen A. Skirius, Dept. of Chemistry, Florida State University, Tallahassee, FL 32306-3006

The ever increasing availability of VCR's and television monitors has taken them from the ranks of "audio/visual aids" to a powerful and necessary tool to be used for instruction. The camera's lens becomes the eyes of the student, enabling him to envision phenomena that would not normally be possible. He would be able to see results from equipment that is not available to him or from experiments that are too risky to be performed in anything but controlled laboratory conditions.

Some equipment and types of video presentations will be displayed.

240 SCIENCE EDUCATION IN THE 1990's: ISSUES AND OPPORTUNITIES. Bassam Shakhashiri, Asst. Director, SEE., National Science Foundation, Suite 516, 1800 G Street, NW, Washington, D.C. 20550

241 MICROCOMPUTER AS ELECTRONIC BLACKBOARD: A COURSE IN ORGANIC CHEMISTRY. Joseph Casanova, Department of Chemistry, California State University, Los Angeles, Los Angeles, CA 90032.

We have used a Macintosh IIcx with 4 MB RAM as the principal lecture delivery vehicle for the year course in organic chemistry while preserving the conventional, professor-centered classroom setting. Nearly all the lecture material is contained in the microcomputer, which we have sought to make as unobtrusive as possible. Software has been kept as simple and standard as possible so that others may easily adopt and adapt it. The central software is Hypercard, which interleaves: *Molecular Editor* (Drexel University, Kinko's Academic Software); *PC Model 2.0* (Serena Software); *Excel 1.5* (Microsoft); *Chem 3D Plus 2.01* (Cambridge Scientific Computing); *Videoworks 2.02* (MacroMind Software); and *ChemConnection 1.42* (SoftShell International). With this approach we have taken advantage of techniques such as reiteration, review, dissolve, animation, and emphasis that are not available in traditional environments. By far the most important aspect of the method is to illustrate points that we recognize as conceptually difficult for students in a traditional environment: visualization of three-dimensional molecular structures and real-time illustration of the interrelation of several variables of important algebraic relationships. The Academic Program Improvement fund of the California State University and lottery funds of the California State University, Los Angeles funded this project during the 1989-90 academic year.

242 PLANE GROUP SYMMETRIES: A PROGRAM FOR MAC COMPUTERS. M. E. Kastner, Department of Chemistry, Bucknell University, Lewisburg PA 17837.

Point group symmetry is of obvious importance to chemists, and some attention is devoted to teaching symmetry in organic, inorganic, and physical chemistry courses. In the solid state, translational symmetry gives rise to space groups. As part of an introduction to space groups in a crystallography course, I use a program developed by Dr. Greg Adams, Mathematics Department, Bucknell University for use on Mac computers. The program allows the user to draw a pattern with the mouse and then choose one of the seventeen plane groups from a pull-down menu; the program then generates the symmetry related patterns in that plane group. The result is similar to wall paper or cloth designs, with recognizable repeating units. The user can create a pattern that itself has point group symmetry, and then generate the repeating pattern in which the point group symmetry either does or does not coincide with the space group symmetry. This program, together with a commercially available program, "Introduction to Crystallography" by David Y. Curtin, University of Illinois, Urbana, provide students interactive exercises that help to develop an understanding of three-dimensional symmetry and space groups.

243 SPREADSHEETS IN UPPER-LEVEL CHEMISTRY COURSES. David M. Whisnant, Department of Chemistry, Wofford College, Spartanburg, SC 29301.

Spreadsheets can be thought of as very high-level programming languages that, although not as flexible as traditional languages, are much easier to learn and use. Because of this, spreadsheets make computers accessible to a broader range of persons without the need of prior computer experience. For the past few years we have made SuperCalc4 available to our chemistry majors to help them analyze and graph data. A number of "what if" simulations also have been developed for student use in physical chemistry. In this session I will furnish the initial handout that helps students learn to use spreadsheets, the numerical templates that we furnish our students, and a number of physical chemistry simulations. Participants who are new to spreadsheets can use the initial handout to see how templates can be developed to help solve chemical problems. They, as well as experienced spreadsheet users, also can work with the simulations to see how spreadsheets can be used to explore the models we develop in our lectures.

244 USING KC? DISCOVERER IN A SOPHOMORE INORGANIC COURSE. John C. Kotz, Department of Chemistry, State University of New York at Oneonta, Oneonta, NY 13820.

The program "KC? Discoverer" (*JCE: Software* **1988** *1B*(1)) has been used for two years in a sophomore inorganic chemistry course. It provides a consistent, easy to use source of data, allows students to make a variety of graphs involving the numeric data, indicates chemical reactivity of the elements, and serves as the basis for both problem sets and examination questions. It has been used throughout the semester both in lecture and for student assignments. The new approach to teaching descriptive inorganic chemistry that it provides appears to be quite successful.

245 APPLICATIONS OF MATHEMATICAL SOFTWARE IN TEACHING QUANTUM CHEMISTRY. William F. Coleman, Department of Chemistry Wellesley College, Wellesley, MA 02181.

In this session participants will use MathCAD (registered trademark of MathSoft, Inc., Cambridge, MA) to work with several quantum chemical concepts that are found in the junior-senior physical and inorganic chemistry courses. Topics to be covered include examination of radial distribution functions, three-dimensional plotting of atomic and molecular orbitals, Huckel MO theory, the evaluation of overlap integrals, and various spectroscopic calculations. These topics make use of most of the major features of this software package, including plotting in two and three dimensions, solution of simultantous equations, matrix manipulations, and differentiation and integration.

246 THE USE OF COMPUTERS IN THE ORGANIC CHEMISTRY CURRICULUM. Sandra I. Lamb, Dept. of Chemistry and Biochemistry, UCLA, Los Angeles, CA 90034-1569

Organic chemistry requires both 3-dimensional visualization of structure and pattern recognition in various types of spectroscopy, both of these capabilities are among the more difficult aspects of the organic curriculum. Sophomore level organic chemistry at UCLA has begun incorporating computer demonstrations and assignments in molecular modeling as an integral part of instruction. Using PCModel by Serena Software (available on DOS based systems, Macintosh II and Silicon Graphics Workstations), students learn to determine energy minima, recognize stable conformations, and to understand stereochemical conversions and structural limitations.

Introductory students are also introduced to spectroscopy early in the curriculum and have the opportunity of working with NMR and IR simulators (DOS and Macintosh) as well as using SpectraDeck (Macintosh) by Paul Shatz. These programs give the student the opportunity of doing experiments with the computer that mimic the use of the real instrument while protecting expensive instrumentation. Spectra Deck is unique in the way that students may interact with the program to gain insights into the interpretation of proton and ^{13}C resonance spectra as well as IR and also Mass Spectra.

247 NEUTRON ACTIVATION ANALYSIS: SOLVING THE MYSTERY OF AIRBORNE RARE EARTHS. G. E. Gordon, Department of Chemistry and Biochemistry, University of Maryland, College Park, MD 20742.

Concentrations of about 35 elements, many of them trace species, can be measured without chemical separations by instrumental neutron activation analysis. Samples are irradiated with neutrons to transform some of the stable isotopes of the elements to radioactive isotopes. Elements are identified and their concentrations are determined by observing energies and half lives of the γ rays emitted by the irradiated samples, as the combination of energies and half life are unique to certain isotopes. Sources of particles in the air can be identified by their detailed composition patterns ("chemical fingerprints"). Studies in Philadelphia revealed concentrations of rare earth elements about forty times greater than expected. The story of the discovery of the sources of these elements illustrates the fact that much scientific progress is made more by accident and chance encounters than is indicated by the classic "scientific method." The trail leads eventually to the possible discovery of a tracer for emissions from motor vehicles, which is needed now that leaded gasoline is nearly phased out.

248 NEUTRON ACTIVATION ANALYSIS AND VOLCANOES, W.H. Zoller, Department of Chemistry, BG-10, University of Washington, Seattle, WA 98195

Samples of atmospheric particulate material have been collected at numerous volcanoes and analyzed by Instrumental Neutron Activation Analysis. The results of the analyses show the presence of the elements S, Se, Sb, Cd, In, Cu, Zn, Ag, Au, Hg, Pb and the Halogens in concentration much higher than would be expected from the magna itself at all of the volcanoes studied. These elements are called the "enriched elements" and each is volatile or has simple volatile compounds that are formed in the volcanic gases, usually halides. In addition, studies of the Hawaiian volcanoes, Mauna Loa (1984) and Kilauea (1983-87) have shown the presence of the platinum elements Os, Ir and Re in surprisingly high concentrations. This latter group of elements are related to sources of metallic elements to the environment. The mechanism of enrichment in the vapor phase and fractionation from the magma will be discussed as well as the implications for the environment as compared to anthropogenic emissions. Particular emphasis will be placed on how the samples are collected, and the different elemental "signatures" of each volcano studied.

249 NEUTRON ACTIVATION ANALYSIS IN SCIENTIFIC CRIME INVESTIGATION, Vincent P. Guinn, Department of Chemistry, University of California, Irvine, California 92717.

For the past 25 years, nuclear-reactor-flux neutron activation analysis (NAA) has been used extensively for the elemental analysis of evidence specimens in criminal cases, and the results frequently presented in court. The most frequently analyzed materials are bullet lead, shotshell pellets, primer gunshot-residue, paint, glass, and hair. Except for the detection of gunshot-residue elements (Ba and Sb), the nondestructive, purely-instrumental, form of the method (INAA) is used. For most of the other materials, the objective is to ascertain whether or not two or more evidence specimens have a common manufacturing origin, as evidenced by the closeness of matching of the two or more specimens in their concentrations of as many trace, minor, and major elements as can be readily measured. The great sensitivity of the method for a large number of elements is thus of value, enabling even very tiny samples to be analyzed with very good precision and accuracy. The most recent developments in this field will be discussed, and the use of INAA in some famous criminal cases will be described (e.g., the President Kennedy assassination).

250 THE ROLE OF RADIOCARBON IN AIR POLLUTION RESEARCH. Ann E. Sheffield, Department of Chemistry, Allegheny College, Meadville, PA 16335.

Radioactive ^{14}C is produced in the upper atmosphere at a roughly constant rate and becomes distributed throughout the atmosphere and the terrestrial food web. When a plant or animal dies, the radiocarbon decays with a half-life of 5730 y. In fossil fuels, no ^{14}C remains. Therefore, carbonaceous pollutants released when fossil fuels are processed or burned contain no ^{14}C, while natural emissions contain the level of radiocarbon typical of living tissue, and emissions from nuclear power plants and weapons tests are enriched in ^{14}C. Radiocarbon can thus serve as a "tracer of opportunity" to distinguish natural emissions from those caused by human activities. In this paper, recent applications of the radiocarbon tracer method to problems in air pollution research are reviewed. Then, I examine in detail how ^{14}C has been used to apportion sources of the low-polarity organic fraction extracted from atmospheric particles collected in Albuquerque, NM. The low-polarity fraction is of particular interest because it contains carcinogenic polycyclic aromatic hydrocarbons.

251 ARCHAEOLOGY AND NUCLEAR CHEMISTRY. M. James Blackman, CAL, Smithsonian Institution, Washington D.C. 20560.

One of the major problems faced by archaeologists attempting to deal with questions involving the emergence and evolution of ancient societies, is how to monitor abstract processes from the material remains recovered in excavations. These processes include 1) the impact of long range trade and cultural contacts on the developmental trajectories taken by these societies; 2) the organization and administration of production and distribution of the products of craft and early industrial activities; and 3) the management and coordination of information flow and the decision making process in early complex societies. The use of instrumental neutron activation analysis to chemical characterize archaeological materials such as obsidian, ceramics, and clay sealings and tablets, provides information, critical to the understanding of these processes. This paper will discuss the theory underlying chemical characterization studies and present examples from recent research projects in the ancient Near East.

252 ***THE CHEMISTRY OF CHROMIUM.*** John C. Kotz, Alexander Ide, and Anne Whitesides, Chemistry Department, State University of New York, Oneonta, NY 13820

We have explored the chemistry of chromium in three ways. First, we have developed a computer database of sources of general information on chromium and its compounds; the database is available on a 5 1/4" disk to anyone wishing a copy. Second, a series of classroom demonstrations that illustrate chromium chemistry has been developed. Third, laboratory experiments, suitable for high schools students, as well as for college students at the introductory and more advanced levels, have been developed. Each of these aspects of the project will be described and illustrated in detail.

253 CHEMICAL REACTIVITY OF NICKEL. James P. Birk; Martha Ronan, Department of Chemistry, Arizona State University, Tempe, AZ 85287-1604; Imogene Bennett, Chaparral High School, Scottsdale, AZ; Cheri Kinney, Marcos de Niza High School, Tempe, AZ

The chemistry of nickel is dominated by oxidation state +2. Most reactions of nickel(II) are either complex ion formation (or substitution) reactions or precipitation reactions. Typical reactions of these types can be demonstrated with a "nickel one-pot" reaction scheme. Other reactions are those characteristic of the anion in nickel(II) compounds. Nickel is used extensively in the metallic state in alloys or as a protective nickel plate resulting from electrolysis. Higher oxidation states are found in oxides commonly used in nickel/cadmium batteries.

254 REACTIONS OF SULFUR AND SOME OF ITS COMPOUNDS. R.J. Gillespie and D.A. Humphreys, Department of Chemistry, McMaster University, Hamilton, Ontario, Canada, L8S 4M1.

Some reactions of sulfur and some of its simpler compounds will be discussed. The particular reactions chosen: (1) illustrate the properties of sulfur as a typical nonmetal, (2) introduce and illustrate important concepts and principles, (3) make good lecture demonstrations and laboratory experiments.

255 CHLORINE AND BROMINE. W. D. Perry, Dept. of Chemistry, Auburn University, Auburn, AL 36849

As part of the REACTIVITY NETWORK Project, a review on the inorganic chemical-reactivity of chlorine and bromine has been prepared. This review presents some of the descriptive inorganic chemistry of chlorine and bromine along with demonstrations and experiments that can be performed in a high school chemistry class.

256 CHEMICAL REACTIVITY OF ALUMINUM. Zaida C. Morales-Martinez, Chemistry Department Florida International University, University Park Campus, Miami, FL 33199: Elizabeth Bednar Moore, Miai Southridge Senior High School, Miami, FL 33157; Evelyn DuCharme, South Miami Senior High School, Miami, FL 33153

The chemistry aluminum is influenced by the following properties: amphoterism and the ability to form "alums" and "lakes". Its reactivity is masked by the formation of a thin protective oxide coating on the metal that prevents further oxidation. This makes aluminum a potential element for accumulation as waste and explains, in part, the need for its recycling. Demonstration experiments, including some using soft drinks aluminum cans, suitable for all grade levels will be performed. A "charming" video microscopic demonstration will be included.

257 AN ALKENE ADDITION REACTION: Mary H. Bailey, Department of Chemistry, The Ohio State University, 120 W. 18th Ave., Columbus, Ohio 43210

When chlorine water is added to tomato juice or a slurry of grated carrot in water, chlorine adds across the double bonds in carotene. The system of conjugated double bonds is destroyed, and the colored mixture turns white. This colorful demonstration can liven up a lecture on alkene addition reactions.

258 THE HYDROGEN IODIDE AND CHLORINE REPLACEMENT REACTION. Ralph A. Burns, Chemistry Department, St. Louis Community College-Meramec, 11333 Big Bend Boulevard, St. Louis, MO 63122

A replacement reaction of colorless hydrogen iodide gas with pale green chlorine gas to produce purple-violet iodine vapor will be performed as a quick lecture demonstration. This vivid demonstration can be used when introducing nonmetal replacement reactions or redox reactions. It can also be used when discussing kinetics, reaction mechanisms, or thermodynamics. During the demonstration, a 16 ounce wide-mouth bottle is filled with chlorine gas and covered with a glass square. The stopper of a 32 ounce wide-mouth bottle of HI gas--prepared in advance--is then removed and the bottle is quickly covered with a second glass square. The covered bottle of HI gas is then inverted and placed upsidedown on top of the bottle of chlorine gas. As the two glass squares separating the bottles are pulled out, purple-violet iodine vapor immediately fills the bottles. Some iodine may also escape into the room, so some ventilation is advisable. The reaction will then be carried out in aqueous solution and compared with the gaseous reaction. The method of preparing HI gas will be described during the presentation.

259 PRODUCTION AND COMBUSTION OF ACETYLENE. Mary H. Bailey, Department of Chemistry, The Ohio State University, 120 W. 18th Ave., Columbus, Ohio 43210

Production and combustion of acetylene can be carried out in a modified two liter pop bottle. The combustion is explosive and dramatic, but is demonstrated safely with the modified pop bottle. The demonstration provides two equations to balance, the first one easy and the second more challenging.

260 A TORTUOUS ROUTE FOR BLACK POWDER FUSE. John J. Fortman, Department of Chemistry, Wright State University, Dayton, OH 45435.

An entertaining demonstration sequence can be done using black powder fuse which can be purchased from some gun shops or waterproof wick which is available in the model rocket section of hobby shops. The fuse will burn through boards clamped together, beneath a pile of sand, and under water until it ignites a line of smokeless powder (nitrocellulose) which leads to a pile of black powder. This in turn ignites a string fuse attached to a hydrogen balloon which begins an assent (although tethered) before exploding.

261 MORE DEMONSTRATIONS WITH RED CABBAGE INDICATOR. John J. Fortman, and Katherine M. Stubbs, Department of Chemistry, Wright State University, Dayton, OH 45435.

Due to the many different colors and beautiful shades produced by red cabbage indicator with only slight changes of acidity we have found it useful in modifying some classic demonstrations. (a) To 8 beakers containing 100 ml of purple cabbage extract diluted with tap water are added various numbers of drops of household ammonia or white vinegar. A spectrum of various colors and shades is produced. By diluting the reagents, this can be modified for use with overhead projector cells. (b) A small amount of red cabbage indicator solution is made green with a minimum amount of household ammonia. Blowing through the solution causes it to turn blue and eventually red-violet. In similar fashion a piece of dry ice can be added to a large graduate cylinder or 2-liter soft drink bottle. The gradual change of colors is eye-catching. (c) Red cabbage extract with acetic acid can be used in place of universal indicator in an ammonia fountain with a number of round bottom flasks connected in series for a striking series of colors.

262 TWO-COLOR FORMALDEHYDE DOUBLE CLOCK SALUTES. John J. Fortman, and Jeffrey A. Schreier, Department of Chemistry, Wright State University, Dayton, OH 45435.

Schools that have colors of orange, gold, or yellow, in combination with blue or black have been fortunate to have the "Old Nassau" double clock reaction for school salutes. Other color combinations have been done in separate beakers with single clock reactions using the formaldehyde clock, and other sequential color changes are possible using the oxidation of thiosulfate by perodate which can give a range of colors. However, due to the lack of indicators with a green color, chemical demonstration salutes to schools with colors including green have not been noted. By using a mixture of indicators and the formaldehyde clock reaction we have developed a clear to gold (yellow) to green clock, as well as clear to gold to red. Doing the two side by side or in a row of alternating beakers makes for a nice green and red Christmas demonstration.

263 A MINIATURE HOT AIR BALLOON FOR ILLUSTRATING CHARLES' LAW; William C. Deese, Department of Chemistry, Louisiana Tech University, Ruston, LA 71272.

It is common for general chemistry texts to refer to hot air balloons when discussing the properties of gases. In fact, Jacques Alexander Charles and Joseph Gay-Lussac were both balloon enthusiasts. During this presentation, instructions for building a miniature hot air balloon from tissue paper will be given. An apparatus for flying the balloon up and down a guide wire will then be demonstrated.

264 IDENTIFYING PLASTICS BY DENSITY. Doris K. Kolb and Kenneth E. Kolb, Bradley University, Peoria, IL 61625

A simple method for identifying unknown plastic materials is based on their densities. Various kinds of plastics can be identified by dropping small samples into cylinders filled with a series of liquids of known density. Polystyrene, polypropylene, high and low density polyethylene, polyvinyl chloride, Nylon, Teflon, Plexiglas, and polyethylene terephthalate can all be identified by this method.

265 COMPARING WATER CONTENT OF MARGARINES. A. Donald Glover and Kenneth E. Kolb, Bradley University, Peoria, IL 61625

When similar samples of margarine of various types are melted, the liquefied materials separate into layers, an upper layer of fat and a lower aqueous layer. The percentage of water in the samples can vary quite dramatically, diet margarines having especially high water content. Margarine samples can be easily melted in test tubes placed in a hot water bath. They can be melted even more easily in a microwave oven. Percent (by volume) of water can be readily estimated.

266 DIFFRACTION GRATING SPECTRA. Edward A. Mottel, Department of Chemistry, Rose-Hulman Institute of Technology, Terre Haute, IN 47803-3999.

Plastic diffraction grating is relatively inexpensive and the spectra it produces can be used as a good introduction to the study of the colors of metal complexes. Students often think of a compound as having a specific color rather than as an absorber of a complementary color. In addition, some light sources give surprising results, leading to the question "So what exactly do you mean by a *color* television?"

267 FIVE-MINUTE DEMONSTRATIONS - A COLORFUL DISPLAY OF THE SCIENTIFIC METHOD. George L. Gilbert, Department of Chemistry, Denison University, Granville, Ohio 43023

A variation on the rainbow color demonstration will be used to explore the types of observation, hypothesis making and prediction which typify the use of a "scientific method" in chemistry. Other correlations with learning will be offered.

268 ALDOL CONDENSATIONS: COLOR FORMATION AND RATE. Ernest F. Silversmith, Morgan State University, Baltimore, MD 21239.

Hydroxide-catalyzed conversion of benzaldehyde and acetone to 1,5-diphenyl-1,4-pentadien-3-one (I) is an effective demonstration of the aldol condensation (King and Ostrum, J. Chem. Educ. 1964, 41, A139). The yellow color of I begins to form as soon as the reagents are mixed; the color is due to the fact that I is more conjugated than the reactants.

Extensions of this demonstration show that (1) the color becomes orange when p-dimethylaminobenzaldehyde is used and (2) the rate of color formation decreases when $[OH^-]$ is decreased. Thus, the demonstrations can lead to discussions of (1) the relationship between λ_{max} and conjugation and (2) the kinetics of the reaction.

269 A SIMPLE ELECTROCHEMICAL CONCENTRATION CELL. John V. Rund, Department of Chemistry, The University of Arizona, Tucson, Arizona 85721.

A concentration cell is one in which the oxidation and reduction reactions are the same, leading to a standard cell potential of exactly zero. The calculation of the cell potential involves only the second term of the Nernst equation, usually an insignificant contributor to the overall voltage in cell that has a cathode reaction different from the anode reaction. In this demonstration, a single beaker is used, and one solution is simply poured on top of the other. The concentration ratio is 1:100 and n = 2, so n cancels logQ, leaving a calculated cell potential of 0.0591 V; in practice the cell usually produces 51-55 mV.

270 WEAK ELECTROLYTES: METAL ION COMPLEXES. Jerry A. Bell, Department of Chemistry, Simmons College, Boston, MA 02115

Since many metal-ligand complexes carry a net charge, we do not often think of them as "weak electrolytes", that is, species that dissociate incompletely in aqueous solution. Many of the common ligands are molecular species, not ions, in solution, so the dissociation is not so obviously analogous to the more usual examples of weak acids and bases. However, it is important, I believe, to make as many interconnections among chemical systems as possible, in order to help students see the universality of the equilibrium concept, rather than thinking about it piecemeal as a lot of specific cases. The equilibria among the mercury(II) and iron(III) cations and the chloride and thiocyanate anions are the basis for a quick, easily-visualized (on the overhead projector) series of transformations that demonstrate the relative strengths of the electrolytes involved as well as some interesting chemistry of mercury(II) that is not often presented in the first chemistry course.

271 A SIMPLE DEMONSTRATION OF AIR PRESSURE. Jerrold Greenberg, Yeshiva High School of Atlanta, Atlanta, Georgia 30340.

Many textbooks and demonstrations attempt to show that air pressure, pushing down on the surface of a liquid, will force water up a tube immersed in the liquid. This may be confusing and difficult for students to visualize. This simple demonstration shows that air pressure works upwards, too.

272 A QUICK CATALYST DEMONSTRATION. Patrick E. Funk, Dept. of Chemistry, Watkins Memorial High School, 8868 Watkins Road, SW., Pataskala, OH 43062.

Describing the operation of a catalyst is often a very difficult task for Chemistry teachers. This poster session will show a very simple method of demonstrating how we think a catalyst might work. Additionally, this demonstration can be expanded to form a paper clip "polymer". Required materials are a dollar bill and a few paper clips.

273

POLYMER TOPICS IN UNDERGRADUATE ANALYTICAL CHEMISTRY. T.J. Vickers, R. Alamo, C.K. Mann and L. Mandelkern, Department of Chemistry, Florida State University, Tallahassee, Florida 32306-3006

Polymer chemistry has been made a part of the course work required of all chemistry majors by incorporating suitable material in the undergraduate course on advanced analytical chemistry. Laboratory exercises and complementary lecture material on characterization of synthetic polymers by infrared spectroscopy, thermal analysis, and gel permeation chromatography have been added to the course. This has been done without expanding an already busy laboratory course by reorienting some exercises and by considerable use of computer simulation "dry labs" for some important, but otherwise time consuming exercises. The three polymer exercises will be described.

274 POLYMER APPLICATION IN CONSTRUCTION ENGINEERING, D. Feldman, Centre for Building Studies, Concordia University, 1455 de Maisonneuve Blvd., West Montreal, Québec, CANADA H3G 1M8

Modern Building materials is the title of a course offered at Undergraduate, Master, and Ph.D. level at the Centre for Building Studies of Concordia University, Montreal, Canada. The course is designed as an introduction to polymer applications in the construction industry for students of building, civil, and chemical engineering and of architecture and materials science.

The first chapter is an introduction to polymer chemistry and technology. It provides information on different classes of high polymers and the manner in which they are synthesized. Some physical and mechanical characteristics of polymers are underlined as well as the procedures used for their processing. The next chapters cover the following topics: composites, polymer-concrete composites, polymer foams, adhesives and sealants, polymers in solar energy conservation, polymer applications in roofing and flooring, coatings, polymer degradation.

275 THEORETICAL APPLIED CHEMISTRY. F. Michael Akeroyd

Bradford and Ilkley Community College, Great Horton Road, Bradford BD7 1AY U.K.

This paper argues that the inclusion of topics such as biotechnology and materials science into future school chemistry curricula requires a concomitant overhaul of the traditional method of teaching fundamental concepts of covalent bonding and periodicity. This paper contains developments from the authors early ideas published as 'Pi-bonding without Tears' (J. Chem. Educ. 1982, 59, 371) and 'Chemical Education in the Year 2000' (J. Chem. Educ. 1983, 60, 559).

276 INTRAMOLECULAR CHARGE EFFECTS - BACK TO ELECTROSTATICS.
George I.H. Hanania and Steven O. Russo, Department of Chemistry, Indiana University, Bloomington, IN 47405.

Most inorganic and biochemical compounds have structures that carry net electrical charge. Electrostatic forces within and between such structures are very strong and decrease with increasing distance more slowly than other types of forces. We show that a wide range of chemical phenomena can be interpreted in terms of charge effects, using the same basic approach of a low-dielectric cavity model. This approach is applied to: (1) factors that modulate acidity and determine pKa values for polyprotic acids; (2) factors that promote the ionization of side groups in ligands in metal coordination complexes, as well as the pH variation of redox potentials in such systems; (3) electrostatic contributions to the stabilization of micelles and of tertiary structure in biomacromolecules; (4) predicting and interpreting H^+ titration curves of gobular proteins. It is also instructive to consider intermolecular electrostatic interactions, such as the effect of ionic strength on rates of ionic reactions, and the role of electrostatic forces in stabilizing macromolecular quaternary structure.

277

ORGANIC TUTORIAL. Bruce N. Campbell, Jr., SUNY Potsdam, Potsdam, NY 13676.

This year an Organic Tutorial course was offered to students who were enrolled in the first semester of the year Organic course and wanted extra help in the course. A number of traditional and nontraditional approaches were used. These will be described and a tentative evaluation attempted.

278 X-RAY CRYSTALLOGRAPHY: A FOUR-WEEK, NO-LECTURE, HANDS-ON COURSE FOR UNDERGRADUATES. M. E. Kastner, Department of Chemistry, Bucknell University, Lewisburg, PA 17837.

X-ray crystallography is commonly used to determine the structure of compounds in the solid state. NSF-ILI Grant #USE-8951058 allowed Bucknell University to purchase a Siemens R3 Automated Single Crystal Diffractometer. To begin to teach students to read the crystallographic literature and to use crystallography to determine structures, I offered a course during our four-week January session. Seven students (one graduate student, one senior, four juniors and one freshman) enrolled. No formal lectures were given, and the informal instruction periods were very brief. Instruction included reading assignments, computer tutorial programs, paper-and-pencil exercises, computer calculations and graphics based on published data, video taped, hands-on use of the precession camera, use of a spreadsheet program (EXCEL) for exploring scattering factors and refinement calculations, and demonstrations. Assuming that some of the students will have used the background provided in the course in research projects before the 11th BCCE, a progress report will be made.

279 CLUSTERS, A DIFFERENT PHASE OF MATTER:A GRADUATE COURSE. Muriel B. Bishop, Department of Chemistry, Clemson University, Clemson,SC 29631 and M. A. Duncan, Department of Chemistry, University of Georgia, Athers, GA 30602

A graduate course in cluster chemistry will be described. The term cluster means different things to different people: a collection of molecules on a surface, complexes in the condensed phase, large inorganic and organometallic complexes, isolated gas phase assemblies, or assemblies existing in matrices. Clusters are aggregates of two or more molecules or atoms held together by weak interactions such as van der Waals, hydrogen,electrostatic, or weak covalent bonds. Since clusters may be the bridge between the atomic or molecular state and bulk material, they are of interest to scientists in many disciplines as models for studying optical and electronic properties, superconductors, heterogeneous catalysis, metal-metal bonding, and species in the atmosphere and intersteller space. They are of interest as possible sources of new materials with tailor-made properties.

280 HOW TO MAKE TEACHING ABOUT POLYMERS INTERESTING AND FUN. Robert Alan Shaner, Department of Chemistry, South Side Area High School, Hookstown, Pa. 15050.

The study of polymers can make an ordinary chemistry classroom explode with fun and excitement for the teacher and students. This session will look at many interesting and exciting ways to present polymer science to students. Some of the topics to be covered will include liquid crystals, slime, studying polymers using rubber bands, experiments with polystyrene, and experiments with the super-absorbant polymer J550.

281 ORGANIC CHEMISTRY AT A RURAL COMMUNITY COLLEGE
Leo Kling III, Faulkner State Junior College, Hammond Circle, Bay Minette, AL, 36507, 205-937-4384

A discussion of the preparation of the community college instructor and the students for organic chemistry. The unique situations and problems of teaching a small section of organic chemistry will be discussed. Some advantages and disadvantages inherent in a small isolated setting will be reviewed. The community college offers unique opportunities and unique challenges for teaching organic chemistry.

282 THE LONE CHEMIST: CHALLENGES OF THE ONE-PERSON CHEMISTRY PROGRAM AT A FOUR YEAR COLLEGE. Mary F. Dove, Division of Natural Sciences, Mobile College, Mobile, AL 36613

The "lone chemist" is a common phenomenon at small four-year colleges. A chemist in this environment faces special problems, most of which fall into three categories: pedagogical, managerial, and psychological, Pedagogical problems are the most serious and often arise from the necessity of teaching courses in all areas of chemistry. The lone chemist must be able to assure the quality of upper-level courses for the major as well as develop courses for non-science majors which are topical and interesting. Some solutions for these problems are presented. Managerial problems involving stockroom maintenance and equipment repair can be overwhelming. The lone chimist should resist the temptation to let things slide in this area. Practical management strategies are suggested. Finally, the lone chemist faces early burn-out, a psychological problem. The symptoms, causes, and cures for burnout are discussed. By recognizing and coping with problems in these three areas, the lone chemist can have a challenging and rewarding career.

283 THE TEXT, TEXT AUTHOR, AND PUBLISHER AS RESOURCES. F. A. Carey, Department of Chemistry, University of Virginia, Charlottesville, VA 22901

The following are but a few of the problems that confront the organic chemistry instructor in the one-person department:
(1) teaches organic chemistry but may not be an organic chemist by training
(2) administrative duties preclude updating lecture notes on an annual basis
(3) office hours set aside to discuss problem-solving with students are too often pre-empted by other responsibilities
(4) human resources (graders, laboratory teaching assistants) may not be available
The ways in which the one-person department can call upon the author and publisher of chemistry textbooks to alleviate these problems are described in the presentation. The message will be that there is more help out there than you might expect.

MICROSCALE ORGANIC LABORATORY IN THE ONE-PERSON DEPARTMENT

284 Randall G. Engel
Green River Community College
12401 S.E. 320th Street
Auburn, WA 98002

Although microscale organic laboratory programs offer many advantages for chemistry departments of all sizes, there are some advantages which are unique to organic laboratory courses taught by instructors in the one-person chemistry department. These advantages will be discussed along with suggestions for implementation of a microscale program on a small scale.

285 "SAFE HANDLING AND LEGAL DISPOSAL OF LABORATORY CHEMICALS AT ACADEMIC INSTITUTIONS"

Dennis D. Graham, Eastern Iowa Community College District, 500 Belmont Rd., Bettendorf, Iowa 52722

Protection of human health and the environment should be a major concern of anyone responsible for use of chemicals. Laboratory chemicals at academic institutions, if improperly handled, could present serious human health and environmental problems.

The Occupational Safety and Health Administration established regulations for the protection of laboratory workers.

The Environmental Protection Agency established regulations on the proper disposal of waster chemicals.

While there are safe waste disposal options available, they can be quite expensive. Reducing the amount of hazardous chemical waste in the laboratory can be a much more cost effective method of dealing with hazardous chemical waste in the academic laboratory.

286 **WHAT SCIENCE SUPPLIERS CAN OFFER SMALL DEPARTMENTS, Marian H. Snow, Fisher Scientific - EMD, 4901 W. LeMoyne St., Chicago, IL 60651**

Small departments or schools often have needs that cannot be met through the large traditional suppliers of science equipment, supplies, and chemicals. These suppliers are usually set up to fill the needs of Government, Industry, and large institutions. Some reputable suppliers have divisions or departments which specialize in these special smaller scale requirements of many educational institutions. Discussion will address some of the needs that can be filled by these specialized divisions, such as smaller-sized chemicals and educational grade supplies and equipment which can stretch smaller budgets.

287 THE THREE-YEAR ICE LABORATORY LEADERSHIP PROJECT: AN OVERVIEW. Marjorie H. Gardner, Lawrence Hall of Science, University of California at Berkeley, Berkeley, CA 94720.

During the summers of 1987-89, a total of 30 award-winning chemistry teachers, winners of Presidential Excellence awards, Conant, or Catalyst awards, gathered at the Lawrence Hall of Science to investigate the role of the laboratory in high school chemistry. This project, a component of the NSF-funded Institute for Chemical Education program at the University of California at Berkeley, had three major goals: (1) to define the contemporary role of the laboratory as a part of secondary school chemistry instruction as the knowledge, skills, and attitutdes students should be able to demonstrate as a result of their laboratory learning, (2) to develop assessment methods to measure and reward student learning that occurs in the laboratory that include more than paper and pencil modes and can be administered nationally as well as locally, (3) to plan for revision and development of experiments that address questions of skills, knowledge, cost and safety, and acknowledge the growing presence of the computer as an interfacing instrument. The project's work and products, including a 194-page monograph, will be highlighted in this opening presentation.

288 THE HIGH SCHOOL CHEMISTRY LAB: SURVIVAL VS. STRICTURES. Darrell H. Beach, The Culver Academies, Box 100, Culver, IN 46511.

Will we witness the demise of the high school chemistry laboratory as the 21st century begins? Can we assess the rewards of the laboratory experience so as to justify the cost of the necessary lab time, equipment, and supplies? These are some of the vital questions that were addressed by a cadre of high school chemistry teachers in the Laboratory Leadership project at the Lawrence Hall of Science. The central issues, concerns, and assumptions that guided this work are highlighted in this presentation.

289 OVERVIEW OF THE LABORATORY COMPONENT: A MATRIX MAP. Otto Phanstiel, Episcopal High School, Jacksonville, FL.

An early concern among the Laboratory Leadership participants was to attempt to identify the full spectrum of student learning outcomes that could be expected from laboratory instruction. It became clear that three aspects were major components in any science laboratory program: (1) Subject matter, approached from a totally different perspective at the lab bench; (2) Personal growth, reflected in students' struggle to build self-confidence, to work as part of a team, and to see themselves as being capably of acting on their environment; (3) Decision making, a natural outcome of their commitment to become involved in the task at hand, their ability to develop critical thinking skills, and finally to see science as a creative outlet for their energies and ideas. A graphic tool, constructed in the form of a triangular matrix, provided the organizing structure for a deeper analysis of these three major components.

290 ASSESSING STUDENT LABORATORY UNDERSTANDING THROUGH "PICTURES IN THE MIND". Helen M. Stone, Ben L. Smith High School, Greensboro, NC 27407.

Prof. Dorothy Gabel, Indiana University, stimulated the Laboratory Leadership group to consider student conceptions and misconceptions concerning the particulate nature of matter. Incorrect or incomplete understanding of the particule model persists, according to research, even among university students. Without this understanding it is difficult to explain chemical reactions, changes in state, and stoichiometry. The term "Pictures in the Mind" has been coined. The Laboratory Leadership group devised a number of laboratory assessment tasks that are based on probing students' mental pictures (at a molecular level) regarding chemical phenomena they have observed in the laboratory. Examples of this innovative approach will be presented and discussed.

291 CULTIVATING WRITING AND COMMUNICATION SKILLS THROUGH LABORATORY-BASED ACTIVITIES AND ASSESSMENT TASKS. Allene Johnson, Summit High School, Summit, NJ

Student experiences in the chemistry laboratory can provide an excellent framework for sharpening their ability to communicate observations, ideas, conculsions, and even their sense of wonder or puzzlement. While some students thrive on the structure of a journal or formal laboratory report, others benefit more from less structured approaches. Other report styles include poems, plays or drawings, abstract writing, and executive summaries. Each has its place in promoting student understanding and can be used to assess the learning that takes place in the laboratory.

292 ADAPTING OLD-HAT LAB ACTIVITIES TO CULTIVATE HIGHER-ORDER OUTCOMES: A WORKSHOP PRESENTATION. Laboratory Leadership Team Members, including Pat Phillips, Griffin High School, Griffin, GA; Floyd Sturtevant, Ames High School, Ames, IA; Gladysmae Good, Arlington High School, Indianapolis, IN; and others.

The monograph produced by the Laboratory Leadership team, titled Laboratory Assessment Builds Success, includes a wide range of innovative laboratory assessment items and ideas for student evaluation. These are written to accompany 18 laboratory activities which are fully-presented in the monograph. None of the laboratory activities are totally new; each is based, at least in part, on well-established and familiar high school lab experiments. However, each has been adapted and re-designed to cultivate "minds-on" (as well as "hands-on") student involvement; in other words, to stimulate higher-order thinking among students. This session will involve participants in the process of adapting an "old-hat" laboratory activity to these new learning goals. Suitable laboratory assessment items for the participant-produced revised activity will be sought and brain-stormed by the group. A learning-by-doing session!

293 "CHEMICAL SENSE" AND LABORATORY SAFETY. Ken Hartman, Ames High School, 20th and Ridgeway, Ames, IA 50010.

Chemical sense is an extension of common sense. Sensible laboratory conduct on the part of students will not happen by memorizing a set of rules, any more than a perfect score on a written driver's test ensures an excellent driving record. The true "driver's test" of chemical sense is students' actual conduct in the laboratory. This session will suggest how instilling proper, safe laboratory conduct among students can be closely tied to students' conventional learning of chemistry concepts and skills. The Laboratory Leadership group regards this as an obligatory part of any laboratory-based chemistry course.

294 ANECDOTAL EPISODES, PARALLEL LABORATORY ACTIVITIES, AND RELATED APPROACHES TO EVALUATING STUDENT UNDERSTANDING. Gladysmae C. Good, Arlington High School, Indianapolis, IN.

Several unconventional ways to assess students' comprehension of their laboratory work will be presented. An anecdotal episode involves describing for students the step-by-step procedure followed by a hypothetical student--a procedure containing one or more errors. (These anecdotes can often be drawn from a teacher's prior observations of student conduct in the laboratory!) Students are asked to identify the errors and to speculate on their consequences. Students can also be challenged to propose a design for an experiment that has characteristics similar to the one they have completed; their description of such a "parallel lab" provides evidence of their understanding of the original lab activity design.

295 HIGH SCHOOL VERSION OF THE WORLD OF CHEMISTRY, Mary Beth Key, Ron Crampton, Edward Gibb, Carole Goshorn, Cliff Schrader, Patricia Smith, St. Albans School, Washington, D. C. 20016

This video-oriented project can open up new vistas for your students as they see new molecular and macroscopic worlds. The HIGH SCHOOL VERSION of THE WORLD OF CHEMISTRY represents a step forward in chemical education. No longer are videos developed as entities to be used separate from the rest of the class. With this project teachers are given a complete set of classroom materials that directly build on the videos. There are "Video Tease" demonstrations and activities ("SHOW AND ASK") that the teacher may use to focus students' attention on specific concepts; Student Viewing Guides, "ANSWERS TO QUESTIONS STUDENTS MIGHT ASK", hands-on activities such as drawing activities that focus on the molecular level ("PICTURES IN YOUR MIND"), student experiments, pair learning activities, suggestions for special student research projects, and so on. The afternoon workshop will be used to demonstrate how the written materials might be integrated with the videos. Several modules will be shown; some common student misconceptions highlighted. There will be a drawing for two complete modules. This project was directed and developed by teachers and funded by the National Science Foundation.

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LABORATORY TECHNIQUES AND RESEARCH SKILLS: A ONE-SEMESTER COURSE TO TEACH SKILLS BASIC TO SCIENCE. M. G. Sibert, Roanoke Valley Governor's School, Roanoke, Virginia, 24015.

Skills and techniques needed for laboratory investigations in both physical and biological sciences are usually acquired during the progress of introductory courses, and then refined in later courses. The large amount of content that has to be learned for most courses often leaves little time to spend on teaching the proper way to use pieces of equipment, perform various tasks, make observations, and collect and record data and handle the data statistically or in calculations. With this in mind, the Roanoke Valley Governor's School, a specialized high school for students interested in science, mathematics, and computers has developed a one semester laboratory course designed to teach skills basic to physical and biological sciences for those students entering RVGS as freshmen or sophomores. This background enables the students to then go into the more advanced science offerings with many of the introductory features already mastered.

297 High School Chemistry Instrumentation Course, Londa Borer and Hans Deuel. Department of Chemistry, California State University, Sacramento, 6000 J Street, Sacramento, CA 95819.

An eight session laboratory course for high school students has been successfully conducted at CSUS for two years. Along with synthesis, the experiments include the use of such instruments as pH meter, IR and UV spectrophotometers, and gas liquid chromatograph. The course design, advertising, funding etc. will be discussed.

298

DO WE HAVE TO THINK TODAY? Kathryn G. Windham
Greensboro Day School, Greensboro, NC 27429-0361

Concrete ideas and methods of improving critical thinking skills among introductory chemistry students will be presented. Specific examples from lecture, lab demonstrations, and class discussion will be offered. Additional ideas will be solicited from the audience.

299 THE BEST LAID PLANS: OBSTACLES THAT MUST BE OVERCOME TO BRING ABOUT LASTING REFORM IN SCIENCE EDUCATION. Amy Phelps and George Bodner, Department of Chemistry, Purdue University, West Lafayette, IN 47907.

Much has been written about the crisis in science education in the U.S. This paper describes what happened when a project designed to improve the problem-solving skills of high school chemistry students was implemented. Our experience provides insight into the obstacles that must be overcome in order to bring about lasting reform in science education. It is not enough to develop good curricula or curriculum materials. Attention must also be paid to the teachers who must implement the proposed changes, because even teachers who tacitly accept the value of these changes face challenges when they try to integrate them into their classrooms.

300 THE TEACHING OF CHEMISTRY IN BOLIVIAN HIGH SCHOOLS. Saul J. Escalera, Dept. of Chemistry, Universidad Mayor de San Simon, Cochabama, Bolivia

The paper presents an overview of the curriculum and methods used in the teaching of Chemistry at the High School level in Bolivia as compared to the United States. It also depicts efforts made in the last decade to promote Chemistry and other related sciences by introducing young students into science fair activities staged annually and sponsored by the National Academy of Sciences as well as the Ministry of Education of Bolivia. Further, the paper includes some information on how University professors are helping by producing textbooks and other types of information on Chemistry in order to promote the teaching of Chemistry at the Junior and Senior High School levels.

301 FUN AND GAMES IN CHEMISTRY CLASS. Deborah G. Courtney, chemistry teacher, Eastside High School, Gainesville, FL 32601.

If you have students who do not have a lot of self-motivation or who complain that chemistry is boring, here are some ideas to get their attention. Having taught average ability high school students for a number of years, this teacher has tried a number of games (chemistry bingo, element probe, jeopardy), puzzles (crosswords, find-a-words), cartoons, puns, jokes, bumper stickers, T-shirts, etc. Handouts include many of these as well as addresses for ordering the bumper stickers, games, crossword puzzle and find-a-word programs. Some of the ideas may be applicable to other grade levels or subjects. Time to share your favorites may also be available.

302 THE MACLECTURE PROJECT: TEACHING CHEMISTRY WITH A MACINTOSH LINKED TO AN OVERHEAD PROJECTOR. Robert J. Brenstein and Conrad C. Hinckley, Department of Chemistry and Biochemistry, Southern Illinois University, Carbondale, Illinois 62901.

Virtually every lecture in chemistry contains material which can be illustrated with the aid of a computer. Although the use of computers is ubiquitous in chemistry, their application as lecture aids is still rare. The MacLecture Project attempts to fill this gap. The project has grown out of the recognition that a computer like the Macintosh SE offers good computational performance and excellent graphics capabilites in a small, portable unit at an affordable price. When coupled with an inexpensive attachment for overhead projection of the computer screen, the system provides easy access to computer graphics and simulations that can be taken to any classroom. HyperCard affords the ease and simplicity of computer control, making the system usable even by instructors with little computer skills. During the talk, we will demonstrate the opportunities the computer offers and share our current experience. We will address problems with integrating computers into lecture presentations and discuss how this technology can possibly lead to changes in chemistry curriculum.

303 INTEGRATING THE LABORATORY AND LECTURE WITH COMPUTERS. M.R. Abraham and Eric L. Enwall, Department of Chemistry and Biochemistry, University of Oklahoma, Norman, OK 73019-0370.

The relationship of large group lecture with multiple laboratory sections has generally fallen into two classes: coordinated and stand-alone. However, in modern inquiry based instructional strategies, a greater degree of relationship is required. The use of computers makes an "integrated" laboratory and lecture possible in large group instruction. One model of "integration" requires one laboratory computer to monitor laboratory work. During laboratory, students are asked to record their data on the computer. The course instructor can then access data in order to utilize it during the lecture to develop concepts. This talk will demonstrate a computer management system presently being used and discuss practical aspects of using such a system.

304 COMPUTER INTERFACING IN A CHEMISTRY LABORATORY: NO PAIN! MUCH GAIN! Richard Wyma and Eric Higbie, Dept. of Chemistry, Indiana-Purdue University, Indianapolis, IN 46205: James May, Arsenal Technical High School, Indianapolis, I N 46201

A variety of hardware and software products have been developed by National Instruments which allow the user to collect and process data from instruments interfaced to computers. Most of these products employe an IEEE-488 interface which is capable of collecting data from 15 different instruments. LABTECH NOTEBOOK, Lotus Measure, Lab Windows, and Lab VIEW have been tested in our chemistry laboratory. This software represent a spectrum of programs requiring little or no programming experience to moderate experience. Advantage and disadvantages of these software packages and their use in an undergraduate laboratory will be discussed.

305 IN-HOUSE PRODUCTION OF PRE-LAB VIDEO PROGRAMS. Howard J. DeVoe, Department of Chemistry and Biochemistry, University of Maryland, College Park, Maryland 20742.

Video is an excellent medium for presenting lab techniques and safety information to college students in large, multi-section general and organic chemistry courses. We have produced short VHS-format video programs for the experiments in three courses. An enthusiastic group of chemistry teachers from local high schools did a large part of the initial planning, taping, and editing over the summers of 1988 and 1989. An important advantage of having our own taping and editing equipment is the ability to quickly revise the programs whenever needed. In our playback setup, video players controlled by an electronic timer are installed at a central location from which the programs are transmitted over a cable network to a 25-inch TV set in each of the lab rooms. Our experience with equipment choice and program production will be described.

306 PRODUCTION AND UTILIZATION OF VIDEO IN LABORATORY INSTRUCTION: Karen E. Eichstadt and Andrew P. Lokie, Jr. Ohio University, Athens, OH 45701.

Techniques and tips for the production of useful vidoes for laboratory instruction will be discussed. Utilization of services from other departments can enhance the efficacy for the venture. Sample videos will be presented.

307 3-D pH PLOTS USING ADVANCED SPREADSHEET SCRIPTING. James O. Currie, Jr., and Richard V. Whiteley, Chemistry Department, Pacific University, Forest Grove, OR 97116

Those teaching in general of analytical chemistry frequently use computer generated titration data for demonstrating buffer behavior, indicator selection, or equivalence point detection. Typically these programs have calculated individual points or entire curves under restrictive parameters. The use of a spreadsheet has the advantage of easy manipulation of the data generated as well as advanced graphing functions. This paper discusses how the use of the HyperScript command language in Wingz on a Macintosh permits complete freedom in generating multiple plots with incremented dissociation constants, concentrations or other variables. True hydrogen ion concentrations can be obtained using activities to correct for changing ionic strength or to simulate the effect of a constant ionic strength buffer. These plots are displayed in color as line graphs of 3-D surface plots. Black and white or color printing is inexpensively done on an Image Writer II or a variety of high resolution printers.

308 INTERACTIVE USE OF THE PERIODIC TABLE VIDEODISC USING THE QUEST™ AUTHORING SYSTEM. Charles E. Sundin, Department of Chemistry, University of Wisconsin-Platteville, One University Plaza, Platteville, WI 53818-3099.

The Periodic Table Videodisc is a wealth of visual images of the common forms of the elements and their reactions with air, water, acids, and base as well as common uses and applications. Images may be obtained using the Video Image Directory and a remote control. However, students may directly interact with the images using a computer, a mouse, and lessons prepared using Allen Communication's QUEST™ Authoring System. Interactive use of the "Journal of Chemical Education:Software's" The Periodic Table Videodisc, Reactions of the Elements using QUEST™ will be demonstrated.

309 THE ROLE OF CHEMISTS IN THE DEVELOPMENT OF NUCLEAR SCIENCE. V.E. Viola, Department of Chemistry, Indiana University, Bloomington, IN 47405

The role of chemists in the development of nuclear science--beginning with the discoveries of Becquerel and Marie Curie--will be briefly reviewed. Among the forefront research areas pioneered by nuclear chemists have been the discovery of new elements and exotic nuclei, nuclear fission, the macroscopic behavior of nuclear matter, and measurement of the nuclear reactions that power the sun. All of these efforts have stimulated the need for nuclear particle accelerators, which now provide a broad range of applications in our technological society.

310 THE SYNTHETIC ELEMENTS, Darleane C. Hoffman,* Chemistry Department and the Nuclear Science Division, 70A-3307, Lawrence Berkeley Laboratory, Berkeley, CA 94720

Prior to 1940, the heaviest element known was uranium, discovered in 1789. Since that time elements 93 through 109, as well as the missing elements 43, 61, 85, and 87 have been synthesized and identified. The techniques and problems involved in these discoveries and the placement of the transuranium elements in the periodic table will be discussed. The production and positive identification of elements heavier than Md (Z=101), which have very short half-lives and can only be produced an atom-at-a-time, are very difficult and there have been controversies concerning their discovery. Some of the new methods which have been developed and used in these studies will be described. The prospects for production of still heavier elements will be considered.

*Supported in part by the Director, Office of Energy Research, Division of Nuclear Physics of the Office of High Energy under Contract No. DE-AC03-76SF00098.

311 NUCLEAR CHEMISTRY AND COSMOLOGY. Richard L. Hahn, Chemistry Department, Brookhaven National Laboratory, Upton, NY 11973.

Concepts from nuclear chemistry/physics are central to many cosmological problems; among these are the "freezing out" of radiation and matter after the Big Bang, the production of energy in stars, the fate of neutrinos produced in the sun (the solar neutrino problem), the formation of neutron stars in supernovae, and the synthesis of the chemical elements. Some of the key ideas from nuclear science that are required in treating such problems will be discussed. In particular, some new experiments to detect solar neutrinos will be described.

The research was carried out at Brookhaven National Laboratory under contract DE-AC02-76CH00016 with the U.S. Department of Energy and supported by its Office of Nuclear Physics.

312 HOW CAN WE UNDERSTAND HOT ATOMIC NUCLEI? John M. Alexander, Department of Chemistry, State University of N.Y. at Stony Brook, Stony Brook, NY 11794-3400

If two atoms (or ions) collide with enough energy to cause their nuclei to touch one another, then a nuclear reaction will occur. The reaction may involve a grazing collision in which only a relatively small amount of matter or energy is exchanged, or it may involve a central collision in which the two atomic nuclei clutch tightly to one another and intermix to form a "compound nucleus". The neutrons and protons inside this compound nucleus are held together by their strong mutual attractions, but they are also in an unstable state of great thermal agitation due to the energy of their formative collision. We can think of this system as a sort of balloon filled with gas molecules where the nucleons are the molecules and their collective mutual attraction (or mean field) leads to a surface tension that acts like an elastic surface barrier or membrane. This outer membrane is actually permeable, and particles do escape from it. It is by measuring the angles and energies of these escapees that we get the information needed to build a mental image or model of the balloon and its contents. Several kinds of experimental measurements will be discussed along with their interpretations. The role of total excitation energy and angular momentum will also be illustrated, along with some ideas of the timescales for energy mixing, collective rotations, particle evaporation and fission-like breakup.

313 ACCELERATORS FOR RESEARCH AND APPLICATIONS. Jose R. Alonso, Lawrence Berkeley Laboratory, 1 Cyclotron Road, Berkeley, CA 94720

The newest particle accelerators are almost always built for extending the frontiers of research, at the cutting edge of science and technology. Once these machines are operating and these technologies mature, new applications are always found, many of which touch our lives in profound ways. The evolution of accelerator technologies will be discussed, with descriptions of accelerator types and characteristics. The wide range of applications of accelerators will be discussed, in fields such as nuclear science, medicine, astrophysics and space-sciences, power generation, airport security, materials processing, microcircuit fabrication.

314 TRACE METAL BIOGEOCHEMISTRY IN THE OCEAN. W.M. Landing, Department of Oceanography, Florida State University, Tallahassee, FL 32306, (904) 644-6037.

The past 15 years have seen tremendous advances in our understanding of trace and heavy metal behavior in marine environments. By adopting "clean-lab" technology and stringent anti-contamination techniques, we now have a clearer picture of how biological, chemical, geological, and physical processes control the distributions, concentrations, and solution speciation of elements such as Fe, Cu, Zn, Cd, and Pb.

Elements with known biochemical requirements (Mn, Fe, Cu, Zn) respond to, and in some cases may control, the biological cycle of photosynthesis and respiration in the ocean. Pollutant metals (Cu, Cd, Pb, Sn) can be used as tracers of man's activities, including fossil fuel combustion and use of leaded gasoline. Submarine volcanic activity at hydrothermal vents releases tremendous amounts of Mn and Fe into the deep sea. Microbial redox processes influence trace metal behavior in a variety of estuarine and oceanic systems. Recent studies have even suggested that global warming may lead to enhanced atmospheric delivery of Fe to the surface ocean, which would in turn cause greater phytoplankton growth, and a resultant decrease in atmospheric carbon dioxide levels, thus acting as a negative feedback mechanisms to buffer the "Greenhouse Effect".

315 BIOMARKERS - THE INTERACTION BETWEEN ORGANIC CHEMISTRY AND GEOLOGY IN PETROLEUM EXPLORATION. R. P. Philp, School of Geology and Geophysics, University of Oklahoma, Norman, OK 73019.

The quest for new reserves of crude oil requires an ever-increasing level of sophisticated exploratory techniques. One such technique that elegantly combines both organic chemistry and geology is based on the so-called biomarker concept. In this approach hydrocarbons in organic rich sediments, or oils, are used to provide us with much information on the nature of source materials, maturity levels, nature of depositional environments and extent of biodegradation. These compounds are also extremely valuable in providing us with information on specific relationships between oils and their source rocks. The purpose of this presentation is to illustrate the analytical techniques involved in detecting these compounds and to provide examples of how you interpret and use the distributions for the purposes of petroleum exploration.

316 PRESERVATION OF ORGANIC MATTER IN WETLAND PEATS: MODERN ANALOGUES OF ANCIENT COAL-FORMING ENVIRONMENTS. William H. Orem and Harry E. Lerch, U.S. Geological Survey, M.S. 956, Reston, VA 22092

Modern peat-forming wetlands are natural laboratories for studies of the earth's carbon cycle and the processes in ancient wetland peats which led to the preservation of organic matter and the formation of fossil fuels. Peat-forming wetlands occur in topographic lows as, for example, the Okefenokee Swamp in southeastern Georgia, or as raised or domed peats in areas of heavy rainfall such as southeast Asia. In both cases, the standing water of the wetland promotes aquatic plant growth and retards the microbial oxidation of dead plant remains, allowing peat to accumulate.

Organic geochemical studies of peats from many different wetlands have shown that the major change in the organic chemistry of plant biomolecules that occurs during the peat stage is the biodegradation of cellulose and other complex plant carbohydrates. In some wetlands, the lignin of vascular plants is also partially or wholly biodegraded. Complex paraffins from vascular plants and algae are the principal components of plant organic matter preserved in peats for later stage conversion to fossil fuels.

317 DEVELOPMENT OF A GEOCHEMISTRY LAB MANUAL. R. H. Langley and E. B. Ledger, Department of Chemistry and Department of Geology, Stephen F. Austin State University, Nacogdoches, TX 75962

We have developed a long needed laboratory manual for courses in geochemistry, environmental chemistry, and agronomy. This manual has been arranged into three section. The first section contains demonstrations that model geological processes. Reactions that occur relatively rapidly may be simulated directly. For example, the precipitation of $Fe(OH)_3$ by the air oxidation of the Fe^{+2} in spring water. Slower reactions, for example, the precipitation of SiO_2, must be modeled indirectly.

The second section, presents various analytical techniques applied specifically to geological systems. Examples include determinations of cations in natural waters by AA spectroscopy, and of radionuclides by gamma-ray spectroscopy.

The third section stresses lab safety and presents general laboratory techniques. This section is primarily designed for students who are not chemistry majors and thus do not have as strong a laboratory background.

318 THE USE OF SOLID STATE ^{13}C NMR SPECTROSCOPY IN DEVELOPING ENVIRONMENTAL AND GEOCHEMICAL QSAR PARAMETERS. William T. Cooper, Department of Chemistry and Terrestrial Waters Institute, B-164, Florida State University, Tallahassee, FL 32306-3006.

Quantitative Structure Activity Relationship (QSAR) techniques are finding increasing use in environmental sciences. QSAR calculations rely on readily available structural, physical and chemical data to predict the biological activity and environmental reactivity of chemicals. Unfortunately, the functional relationship between the environmental and geochemical behavior of chemicals, particularly organic chemicals, and their QSAR parameters is poorly understood. For this reason we have been concentrating on the other side of this problem; QSAR predictions for geological materials such as soils, sediments, and aquifer media. One of the main analytical tools we use is quantitative solid state ^{13}C NMR spectroscopy. In this presentation the quantitative ^{13}C NMR technique will be described and its use in determining the quantitative and qualitative nature of chemically reactive sites in sedimentary organic matter discussed.

319 CHEMSOURCE: AN OVERVIEW. Mary Beth Key, St. Albans School, Washington, DC 20016 and Mary Virginia Orna, College of New Rochelle, New Rochelle, NY 10801.

This paper is an introduction to the half-day symposium on the teacher resource materials comprising ChemSource. Compiled by teachers for teachers, these materials are examples of the best ideas, demonstrations, classroom activities, laboratory experiments and teaching techniques that experienced teachers have found really work. Collected in one place as a braintrust to aid the inexperienced and/or aspiring chemistry teacher, ChemSource consists of SourceBook and SourceView. Each of these components will be introduced and illustrated in detail in the papers that follow. This three-year project, funded by the National Science Foundation, the American Chemical Society and its local sections, and other bodies, is being carried out by highly involved chemical educators nationwide.

320 THE SOURCEVIEW COMPONENT OF CHEMSOURCE. Dorothy Gabel, Indiana University, Bloomington, IN 47405

The SourceView project will produce two hours of professional quality videotape of exemplary chemistry instruction at the high school level. Ten teachers and their students will be portrayed in chemistry learning-teaching situations at their school site. The program will be produced by the Radio and Television department of Indiana University under the direction of Dorothy Gabel. Features of the videotaped instruction will include: (1) Actual teachers with their students filmed in their natural setting; (2) The portrayal of 10 different teaching skills such as introducing the lesson, preparing students for laboratory experiments, presenting demonstrations, etc.; (3) The portrayal of each skill by two different teachers illustrating different teaching styles; (4) The portrayal of expert and novice behaviors in the portrayal of each skill; (5) Focus on using a great variety of skills in teaching one topic in chemistry, acids and bases; (6) Coordination with SourceBook. At this session of the symposium, procedures for the selection and preparation of the teachers and the identification of the skills with their related behavior indicators will be described. First drafts of the instruments that will be used to guide the teachers in the portrayal of the skills and plans for the design of Hypercard stacks and videodisk production will be discussed.

321 SOURCEBOOK: A STRATEGY FOR DELIVERING DAY-TO-DAY SUPPORT FOR CHEMISTRY TEACHING. Marjorie Gardner, Lawrence Hall of Science, University of California, Berkeley, CA 94720, and Henry Heikkinen, Department of Chemistry and Biochemistry, University of Northern Colorado, Greeley, CO 80639.

SourceBook will be a new resource providing specific teaching tips and the best instructional ideas and information gleaned from experienced, successful chemistry teachers related to over thirty topics in the high school curriculum. It will feature laboratory activities, demonstrations, discrepant events, common misconceptions, humor, relevant applications, etc., which support topics ranging from Acids and Bases to Organic Polymers; from Bonding to Halogens. These materials are being prepared by twelve regional Writing Cluster groups of high school and university teachers. General materials on chemistry teaching, laboratory management, and classroom strategies will also be included. SourceBook will be available on disk as a searchable data base and in hard copy format. The SourceBook co-directors will offer an overview and progress report on this ongoing project in this presentation.

322 SOURCEBOOK PREVIEW #1: SUPPORT FOR A CONCEPTUALLY-ORIENTED CHEMISTRY TOPIC: EQUILIBRIUM. Michael Ray Abraham, Department of Chemistry and Biochemistry, University of Oklahoma, Norman, OK 73019.

The ChemSource Writing Cluster facilitator from Oklahoma will provide a close-up look at the detailed materials being prepared in ChemSource to support a typical conceptually-oriented topic, Equilibrium. Using concept maps, pictures in the mind, metaphors and analogies, he will discuss the development of central concepts and skills in this topic.

323 SOURCEBOOK PREVIEW #2: SUPPORT FOR A DESCRIPTIVE CHEMISTRY TOPIC: HALOGENS. Abe Rennert, Manchester High School, 134 East Middle Turnpike, Manchester, CT 06040.

A ChemSource Writing Cluster respresentative from the Massachusetts team will offer a detailed look at the materials currently being prepared in ChemSource to support a typical descriptive chemistry topic, the Halogens. Emphasis will be placed on the operational and conceptual central concepts for this unit and their application to laboratory activities and demonstrations.

324 SOURCEBOOK PREVIEW #3: SUPPORT FOR AN APPLIED/ ENRICHMENT CHEMISTRY TOPIC: BIOCHEMISTRY AND ENZYMES. Lee Summerlin, Department of Chemistry, University of Alabama, Birmingham, AL 35294.

The ChemSource Writing Cluster from Alabama will overview the range of materials being prepared in ChemSource to support an applied/enrichment chemistry topic, Biochemistry and Enzymes. Direct links and connections with everyday events will form the discussion core for this topic.

325 CHEMSOURCE: DISCUSSION AND FEEDBACK SESSION. Mary Virginia Orna, College of New Rochelle, New Rochelle, NY 10801; Mary Beth Key, St. Albans School, Washington, DC 20016; Dorothy Gabel, Indiana University, Bloomington, IN 47405; Marjorie Gardner, Lawrence Hall of Science, University of California, Berkeley, CA 94720; Henry Heikkinen, University of Northern Colorado, Greeley, CO 80639.

The Directors of the various components of ChemSource and the Chair of the Steering Committee will invite informal discussion, solicit ideas, respond to feedback and invite questions regarding all aspects of the project.

326 GRADUATE STUDIES IN CHEMICAL EDUCATION. Panel members present the chemical education programs at their university, following which, an open discussion will be conducted on opportunities for teachers.

Dr. Mary M. Atwater (University of Georgia): A comparison among three doctoral programs will be described: 1) producing a chemical educator for a two or four-year institution, 2) producing a science educator specializing in education research, and 3) producing a science educator whose specialty is the chemistry curriculum or supervision. Dr. Martin V. Stewart (Middle Tennessee State University): The Doctor of Arts degree is designed for the preparation of college teachers rather than university researchers. Thus, the DA provides a terminal-degree alternative to the traditional PhD or EdD. This program has recently received new impetus by the National Doctor of Arts Association. Dr. Henry Heikkinen (University of Northern Colorado): A virtually unique PhD program in chemical education has been initiated, in that it is offered jointly by the Department of Chemistry and Biochemistry. the degree requires graduate research in chemistry and education. Dr. Dudley Herron (Purdue University): At the graduate level, students may elect thesis or non-thesis masters degrees in either chemistry or science education. A PhD from the School of Education is offered in science education. These programs emphasize research on learning and instruction.

327 CEPUP PROGRAM OVERVIEW. R. C. Laugen, Lawrence Hall of Science, University of California, Berkeley, CA 94720

The Chemical Education for Public Understanding Program (CEPUP) at the Lawrence Hall of Science is supported by a materials development grant from the National Science Foundation and through contributions from private foundations and industry. CEPUP is developing activity-based instructional strategies and materials in modular form which focus on chemical concepts and processes associated with current societal issues. The goal of CEPUP is to develop greater awareness, knowledge, and understanding about chemicals and how they interact with the environment and our lives so that people can make informed decisions. This presentation will describe current CEPUP projects: CEPUP in the Schools for middle/junior high students, Chemicals, Health, Environment and Me for 5th and 6th-grade students, Chemicals and Society for the community and workplace, and Living with Chemicals for the community. Other symposium presentations will elaborate on these projects. Symposium attendees will be given the Chemicals in Society materials for their own use.

328 WHY CEPUP? CHEMICAL EDUCATION AND ISSUES. H. D. Thier, Lawrence Hall of Science, University of California, Berkeley, CA 94720.

Understanding about chemicals and how they interact with people and the environment is essential to informed citizenship in this country. It is not societally productive for people to make decisions and set priorities based on emotions. Instead of anxiously demanding answers, people must ask questions, obtain and understand the limitations of scientific evidence, and use this evidence as the basis for their decision making. This presentation will describe CEPUP's approach to teaching chemical concepts and processes by means of social issues, and will emphasize the differences between education and advocacy, evidence and decisions.

329 CEPUP: CHEMICAL EDUCATION IN SCHOOLS. S. Hill, Winston-Salem/Forsyth County Schools, Winston-Salem, NC 27103.

Development and implementation of the CEPUP in the Schools materials are ongoing processes. Centers have been set up nationwide to field-test new materials. Industry-education partnerships which provide teacher training and materials are functioning in many of these centers as well, School districts are integrating the materials into their courses of study. This presentation will describe one district's experiences in field-testing, teacher training, and implementing CEPUP materials.

330 LIVING WITH CHEMICALS: A COMMUNITY PROJECT. E. Anderson, General Federation of Women's Clubs, Tucker, GA 30084, and B. Saiet, Shell Oil Co., Houston, TX 77252.

Living with Chemicals is part of a two-year project adopted by the General Federation of Women's Clubs (GFWC) sponsored by Shell Oil Company. The materials were introduced to over 500 club leaders in the fall of 1988. These leaders and others they have trained have been giving workshops in their communities and are introducing CEPUP to their local school systems. This presentation will outline the nature of this community education program, describe its impact to date, and present plans for the next Federation biennium.

331 CHEMICAL EDUCATION: AN INDUSTRY VIEW. G. Affleck, Hewlett-Packard Company, Palo Alto, CA 94304.

Business and industry have vital interests in chemical education. They must be assured of a steady flow of trained scientists, engineers, and technologists, and are affected by the economic and political decisions related to chemicals that people make. Understanding the information currently required to be made available in the workplace and to the public, e.g. through SARA Title III, has reinforced the need for better chemical education. This presentation will describe one company's perspective, its use of Chemicals and Society in workplace and community education, and its support for CEPUP in the Schools.

332 GETTING STUDENTS TO PROFIT FROM CHEMISTRY. Clifford L. Schrader Dover High School, Dover, Ohio 44622

To make a profit requires a product that is mutually beneficial to both the buyer and the seller. The positive perceptions created by a persuasive sales pitch must be followed by the acquisition of something of value. Profit can be used as a metaphor for teaching and learning chemistry. Students who acquire thinking skills by solving problems profit from chemistry, and if they also make money, the double meaning of the title is apparent. Students in my chemistry class found that learning chemistry was exciting, enjoyable and profitable in both senses.

Solving real world chemical problems is an exciting application of principles learned with text book abstractions. The students in my chemistry classes started a chemical company and the problem was how to maximize their profit. The chemical we bought and sold was no abstraction. Profit was not a dirty word.

333 THE EASY WAY TO DO CHEMICAL DEMONSTRATIONS. Doris K. Kolb, Bradley University, Peoria, IL 61625

There are chemistry teachers who do demonstrations, and there are others who don't. The ones who don't usually explain that they haven't time to prepare demonstrations; nor do they have enough class time to set them up, carry them out, and then clean up before the next class. Doing large-scale demonstrations can also be expensive, and finally demonstrations are just a lot of trouble.

For those who think that demonstrations require too much time, money, and effort, we recommend demonstrations on the overhead projector. They are usually quick, simple, and inexpensive, and every student in the room can see what is going on. A number of quick and easy demonstrations will be presented.

334 RUBE GOLDBERG CHEMISTRY CONTEST. Ron Perkins and Mark Strauss
Science Department, Greenwich H.S., Greenwich, CT 06830

Come see a Rube Goldberg device, consisting of more than a dozen popular chemical demonstrations. Vapor, color changes, luminescence, clocks, music, flags and disappearing coins are all part of the excitement.

The more serious chemical demonstrator is encouraged to participate in a contest to identify the chemicals used. The winning individual or team will receive 100 Cyalume Lightsticks.

335 STUDENT INVESTIGATIONS: DEVELOPING A DEMONSTRATION. Jerry A. Bell,
Department of Chemistry, Simmons College, Boston, MA 02115

Many of us use chemical demonstrations and lecture experiments to motivate student interest, introduce new concepts and chemical systems, and provide data for class discussion and analysis. Almost always, we prepare the demonstration and rarely discuss how it was developed or what the important parameters are in setting it up and making it work "correctly". Many students are interested in presenting demonstrations themselves and teachers can take advantage of this interest by getting them involved teaching parents, peers, and younger students. Usually, however, the students are still working from a "recipe" provided by the teacher or a text. Here's an opportunity going to waste. Why not try letting them develop a demonstration of their own? The demonstration I have chosen for this presentation is "water into wine" (and back) using household products, so that, after a student has perfected her/his demonstration, s/he may set it up at home to amaze, amuse, and teach some chemistry to parents, siblings, and friends.

336 A TOOL FOR TEACHING ACID/BASE TITRATION CALCULATIONS, Carl B. Bishop,
Department of Chemistry, Clemson University, Clemson,SC 29631

A simple guide has been developed which can be used by students for selecting the appropriate equilibrium system needed to solve problems which occur in four regions of an acid/base titration curve. The special meanings and relationships of such terms as the equivalent point, buffers, mid-point of the titration curve, pK 's of acids, relative strenths of the acids/bases, and selection of indicators will be discussed as they are related to these four regions.

337 SYSTEMATIC CALCULATION OF pH FOR COMPLEX SYSTEMS. G. F. Warnock and H. A. Bent, Department of Chemistry, University of Pittsburgh, Pittsburgh, PA 15260

A systematic, graphic, step-by-step procedure for calculating the pH of any mixture of acids and bases will be presented. A table of acid/conjugate-base pairs, listed in order of increasing pK_a, is used to do two things: (1) to carry out neutralizations and so determine the main species remaining and (2) to identify the principal equilibrium and thus calculate concentrations of all species. The procedure allows students to view, from a single perspective, levelling, neutralization, ionization, hydrolysis, disproportionation, and additional, un-named proton transfers. Examples of the procedure will be given, along with appropriate lecture demonstrations.

338 COMPETING EQUILIBRIA IN ACID - BASE SYSTEMS. Lawrence L. Garber and George V. Nazaroff, Department of Chemistry, Indiana University at South Bend, South Bend, IN 46634-7111.

We have been teaching freshman chemistry students how to deal with competing equilibria and how to include activity coefficients in acid-base pH calculations. Our method has been to develop a general procedure for writing out the coupled algebraic equations for the concentrations of the species in each system in terms of several unknowns. These coupled equations are solved approximately and simply using chemical sense. The approximate solutions are then fed into a computer program that generates the exact answers. Activity coefficients are calculated by the computer program using the Davies equation.

339 THE PRINCIPAL EQUATIONS OF REACTION STOICHIOMETRY. Ning Huai Zhou, Department of Chemistry, Hangzhou Teachers College, Hangzhou, 310012, People's Republic of China, and J. Edmund White, Department of Chemistry, Southern Illinois University at Edwardsville, Edwardsville, IL 62026.

Stoichiometry lacks a unifying concept and equation. Some recent suggestions were based on the de Donder "extent of reaction." For a balanced equation: $aA + bB = gG + hH$, if n is the absolute value of the change in the amount of substance, then $n_G = n_A \times g/a = n_B \times g/b = n_H \times g/h$. In the SI system, the volume concentration is the amount of substance concentration, not normality or formality. Thus, the familiar expression, $N_1V_1 = N_2V_2$, should not be used. The basic expression for titrimetric calculations is derived If A is the unknown substance and T is the titrant, $n_A = n_T \times a/t$. Then, the mass of A present is $m_A = M_A \times c_T \times V_T \times a/t$. If the mass of the sample is m_S, then the mass fraction (formerly, weight percentage, w) of A is $w_A\% = M_A \times c_T \times V_T \times a\ 100 / m_S \times t$. In making titrimetric calculations, one must understand all reactions involved and apply these expressions appropriately. Examples will show that, when this approach is applied to any problem in reaction stoichiometry, the solutions are simple and rigorous. These equations have been used in a few recent chemistry textbooks in the People's Republic of China.

340 INTERACTIVE MODEL SYSTEM FOR TEACHING MOLECULAR CHEMISTRY. H. J. Teague, Department of Physical Science, Pembroke State University, Pembroke, NC 28372

An interactive model system has been developed which is used to demonstrate I. structure and mechanism and II. a molecular structure method that ties together Valence Bond (VB)--Hybridization and VSEPR theories. The following concepts will be presented: (1) VSEPR Theory, (2) Structure Configuration: R/S system and enzyme specificity, (3) Mechanism: S_N2, with Inversion of Configuration, and S_N1 processes, and (4) Conformation: Rotation about an atom-to-atom bond, including staggered and eclipsed forms.

341 PREDICTING CRYSTAL STRUCTURE WITH SIMPLE GEOMETRY
Herb Bassow, Germantown Friends School, Philadelphia, PA 19144

Packing and lattice models using styrofoam spheres to represent atoms and ions are shown to be effective tools in explaining observed properties of crystals. Simple geometry is used to predict sizes of trigonal, tetrahedral, octahedral holes in close-packed metals.

A naive approach to atomic and ionic radii, using the work of Barlow (W.Barlow, Sci.Proc.Roy.Dublin Soc. 8, 527, 1893-8) and the Braggs (W.H.Bragg & W.L.Bragg, Proc.Roy.Soc. A88, 428, 1913, and W.L.Bragg, ibid., 89, 248, 1913) allows calculation of these radii. The shift from face-centered to body-centered cubic symmetry is then predicted, and found to be confirmed by the structures of sodium and cesium chlorides.

The usefulness and power of crystal models and high school geometry is thus demonstrated to beginning chemistry students.

342

DESIGNING A USER-FRIENDLY LABORATORY FOR FIRST SEMESTER GENERAL CHEMISTRY. Gail M. Meyer and Gregory J. Grant, Department of Chemistry, The University of Tennessee at Chattanooga, Chattanooga, Tennessee 37403.

Students taking the first semester of general chemistry at the University of Tennessee at Chattanooga begin the course with a wide range of lab experience. In order to give older and/or less experienced students an opportunity to catch up, a trial laboratory component has been designed to reduce anxiety and encourage learning. The development of the grading policy, the experiments used, and the final lab practical exam will be presented.

343

THE LABORATORY COMPONENT IN SECOND SEMESTER GENERAL CHEMISTRY. Gregory J. Grant and Gail M. Meyer, Department of Chemistry, The University of Tennessee at Chattanooga, Chattanooga, Tennessee 37403.

The student audience in the general chemistry course at the University of Tennessee at Chattanooga is a very heterogeneous group--nurses, engineers, chemistry and other science majors, premeds, business majors. The ideas and problems associated with the development of the laboratory component for students with such a diverse background will be discussed. A topical outline of the laboratory in the second semester general chemistry course will be presented.

344 PREPARATION AND USE OF LIQUID OXYGEN. D.M. Sullivan. Department of Chemistry, University of Nebraska at Omaha, Omaha, NE 68182.

Anyone having access to liquid nitrogen can easily prepare liquid oxygen. Small quantities of liquid oxygen can be stored temporarily and used for such experiments as demonstration of paramagnetism, observation of color of liquid oxygen and support of combustion in experiments guaranteed to excite students and generate questions.

345 DETERMINATION OF SOLUBILITY PRODUCT CONSTANT FOR CALCIUM FLUORIDE: A FRESHMAN CHEMISTRY EXPERIMENT. Lawrence L. Garber and George V. Nazaroff, Department of Chemistry, Indiana University at South Bend, South Bend, IN 46634-7111.

The determination of the solubility product constant for calcium fluoride requires the measurement of the activities of fluoride and calcium ions. An ion specific electrode is used to determine directly the activity of fluoride ion in a saturated solution of calcium fluoride and in solutions of calcium fluoride which either contain additional fluoride or calcium. Atomic absorption is used to determine the corresponding calcium ion concentration. The concentration of calcium ion is converted to activity by using the Davies Equation for the estimation of the activity coefficient. Atomic absorption measurements determine not only hydrated calcium ion concentration but also any calcium present in hydrolysis products and ion-pairs. In this particular system hydrolysis product and ion-pair formations have essentially no effect on the total solubility of calcium fluoride. Thus it can be assumed that total calcium concentration is the same as the concentration of hydrated calcium ion. The results obtained agree with literature values.

346 DEVELOPMENT OF AND EXPECTATIONS FROM A MICROSCALE EXPERIMENT FOR THE DETERMINATION OF THE K_a OF A WEAK ACID. Marcia L. Gillette, Chemistry Department, Indiana University at Kokomo, Kokomo, IN 46904-9003 and H.A. Neidig, Lebanon Valley College of Pennsylvania, Annville, PA 17003-0501.

Utilization of microscale experiments in a general chemistry laboratory curriculum produces benefits in addition to the obvious cost and safety advantages. Students pay increased attention to detail, leading to greater involvement and understanding on their part. Because many microscale experiments can be done in an unusually short period of time, repeated trials are frequently possible.

Development of microscale experiments does not involve the simple scaling down of traditional, macroscale procedures. Through an examination of the actual development of the K_a of a weak acid, we will explore the perils of microscale measurements made with inexpensive, disposable equipment. We will consider some sources of experimental error associated with microscale techniques. We must be willing to adjust our expectations when evaluating student results, but this is a small price to be paid for the stimulation and instruction these experiments provide.

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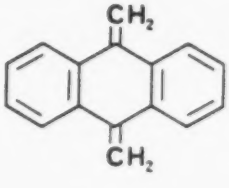
MICRO AND(OR) SEMIMICRO ORGANIC LABORATORY? Bruce N. Campbell, Jr., Chemistry Department, SUNY Potsdam, Potsdam, NY 13676.

Some advantages of both scales for teaching Organic Laboratory will be explored. An attempt to realize the best of both scales will be described. Some organizational and practical details will be included as to problems and attempted improvements. Contributions from the audience will be requested.

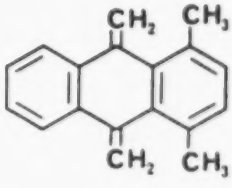
348 **SYNTHESIS OF AN ISOLABLE QUINODIMETHANE.** Stuart Rosenfeld and Sarah VanDyke, Department of Chemistry, Smith College, Northampton, MA 01063

Quinodimethanes, e.g. the parent member of the series **1** and its dibenzologue **2**, are highly reactive species that are not normally isolable. A small number of derivatives of **2**, however, have been isolated and represent interesting synthetic targets for advanced undergraduate students. We have modified the procedures for the synthesis of **3**, originally reported by Bowden and Cameron (*Tetrahedron Letts.* **1977**, 383), to fit the time and equipment limitations of an undergraduate laboratory and will describe the sequence and its use in spawning short independent projects.

1



2



3

349 PREPARATION OF RARE-EARTH AND YTTRIUM GARNETS: A SOLID STATE CHEMISTRY EXPERIMENT. R.H. Langley, N. Nordoff, T. Calcaterra, R. Lancaster and R. Beaty, Department of Chemistry, Stephen F. Austin State University, Nacogdoches, TX 75962

A variety of rare-earth and yttrium garnets may be easily synthesized. These compounds have the general formula $A_3B_5O_{12}$ where A is yttrium or a rare-earth and B is aluminum, iron or gallium. These compounds may be used to illustrate several principles of solid state chemistry. The materials are cubic, and so they are relatively easy to study by X-ray diffraction. They exhibit different types of magnetic behavior. The formation of so many similar compounds demonstrates isomorphous substitution.

350 LASER EXPERIMENTS IN UNDERGRADUATE CHEMISTRY: A PRACTICAL GUIDE. Jack K. Steehler, Dept. of Chemistry, Roanoke College, Salem, VA 24153

Students are fascinated by lasers. Extremely high levels of student interest and excitement are found for laser experiments. Yet lasers are seldom incorporated in undergraduate experiments due to an incorrect perception of complexity. Laser lecture demonstrations and student experiments are possible in all areas of chemistry, including organic and inorganic chemistry in addition to the traditional applications in analytical and physical chemistry. A variety of such demonstrations and experiments will be presented and discussed. A balanced treatment of the pro's and con's of laser experiments will be given, emphasizing the need to keep the chemistry as the focus, not the laser itself. Advice concerning undergraduate research projects using lasers will also be presented.

351 COLORIMETRIC ESTIMATION OF GLUCOSE USING LOW-COST COLORIMETER AN UNDER GRADUATE EXPERIMENT. P. K. Sai Prakash, Dept. of Chemistry, Osmania University Hyderabad- 500 077, India

A simple Colorimetric undergraduate experiment is designed for the estimation of glucose and similar reducing sugars. The method makes use of the reaction of Fehling's solution with glucose and the estimation of the unreacted cupric ions colorimetrically. The colorimeter used is a low-cost instrument fabricated by UGC/DST collaboration under the UNESCO/IUPAC sponsored "low-cost instrumentation program". The instrument costs around Rs.500 in Indian Currency or US $ 30.00.

352 **ENZYMATIC ESTIMATION OF NON-REDUCING SUGARS BY USING LOW-COST COLORIMETER.**
P. K. Sai Prakash, Dept. of Chemistry, Osmania University
Hyderabad- 500 077,India

A simple Colorimetric estimation of Sucrose and raw sugar using a low-cost Colorimeter fabricated by us is presented. The method involves enzymatic hydrolysis of the sugar followed by treatment with Fehling's solution and estimating the unreacted Cupric ions with the low-cost colorimeter. The experiment is most suitable for a laboratory course at the undergraduate level.

353

TAKING TESTS AND LEARNING CHEMISTRY: PHASE II. Mark B. Freilich, Department of Chemistry, Memphis State University, Memphis, Tennessee 38152

General Chemistry lecture grades are often assigned on the basis of three or four quizzes, three major exams and a final exam. At the Tenth Biennial Conference, we reported on our study of the effect frequent quizzing has, when superimposed upon the above, on student performance on the final exam. Consistently, over several semesters, students who took frequent short quizzes for course credit, students who took the same quizzes but not for credit and students who did not take the quizzes averaged approximately the same on the multiple choice final exams. This observation led us to question the value of the comprehensive final exam and the heavy weighting it often carries in assigning course grades. We are now investigating the impact of less frequent but more heavily weighted quizzes. Though the project is likely to continue an additional year, we shall report on preliminary results.

354

UNDERGRADUATE RESEARCH AS A WRITING INTENSIVE COURSE FOR THE GENERALLY EDUCATED CHEMISTRY STUDENT. Richard L. Petersen and Mark B. Freilich, Department of Chemistry, Memphis State University, Memphis, TN 38152.

Students face the same critical writing tasks in undergraduate research projects that professional chemists do. They must keep a notebook to record experimental goals, procedures, and results. They must also submit a formal summary report. General education curriculum reforms at Memphis State University, led us to designate undergraduate research as Chemistry's writing intensive course requirement. We now specify that this course provide frequent opportunities for development of writing and rewriting skills appropriate to undergraduate research and to the discipline of chemistry. Special attention is given to keeping a labbook, with concern for clarity of writing and recording complete and accurate observations. Constructive criticism of writing occurs weekly as student and instructor consult over the record of preceding experiments and outline future work. The final report is taken as a major writing assignment, starting as an outline and progressing through several drafts until a formal product, representative of typical submissions to a professional journal is produced. Faculty often find that students grasp the significance of the experiments only upon summarizing the findings in this formal report.

355 TOLEDO PLACEMENT TEST VERSUS CALIFORNIA DIAGNOSTIC TEST. V. H. Crawford. Department of Chemistry, Mercer University, Macon, Georgia 31207.

The Toledo Placement Test has been used for many years as an instrument for evaluating the readiness of students for entering the standard general chemistry sequence. The latest version of this test is 1981 and no revision seems to be planned. Beginning this year the ACS DivCHED Examination Institute began publishing the California Diagnostic Test. This is being advertised as a successor to the Toledo test, although it was originally designed as a diagnostic, rather than placement, instrument. For several years, entering students have taken the Toledo test and the results used to screen admission into the general chemistry course. These students are tracked in terms of their grades in the first quarter course. This academic year, approximately 80 students also took the California Diagnostic Test. The data indicate a reasonable correlation between the results of the two instruments. The preliminary data from only the first quarter indicate a reasonable correlation between either instrument and course grade.

356 TRENDS AND PREDICTIONS: FRESHMAN CHEMISTRY GRADES AT A MILITARY COLLEGE, Thomas H. Richardson, Department of Chemistry, The Citadel, Charleston, South Carolina 29409

A twenty-year history of student grades in two two-semester freshman chemistry lecture course sequences suggests that a student's decision to attempt the second semester after achieving only a "D" in the first semester is generally ill-advised. Furthermore, regardless of what grade was earned in the first semester, the probability of an improvement in the second semester is unfavorable.

The statistics developed in this study at a military college are being used to establish guidelines for advising continuing students who are enrolled in either of two freshman course sequences, a science and engineering "majors" course or a liberal-arts terminal course.

357 **FRESHMAN CHEMISTRY - HOW TO BEGIN? ORGANIC CHEMISTRY AS THE FIRST COURSE.** R. G. Scamehorn and J. W. Beatty, Jr., Department of Chemistry, Ripon College, Ripon, WI 54971.

For over twenty years we have been teaching organic chemistry in the first semester of our regular chemistry sequence. The course is part of an integrated two-year sequence which also includes inorganic ion chemistry, structural and theoretical principles, analytical chemistry, and a second semester of organic. The reasons for such an approach include (1) course material which is new to most students, (2) course material which is less abstract and more descriptive, (3) less math anxiety, (4) better coordination of laboratories, (5) less dependence on high school chemistry background, and (6) attractive to biology and health professions students. The differences between this course and the first semester of the traditional sophomore organic course include the integration of chemical principles and the coverage of functional group chemistry. We have found this subset of chemistry an appropriate way to begin the chemistry core curriculum. Inorganic and physical chemists have handled discussion and laboratory sections with only modest trauma. Other strengths and weaknesses of this approach will be presented.

358 A LABORATORY COURSE FOR ANALYTICAL, ORGANIC AND PHYSICAL CHEMISTRY: INTEGRATED, INTERGENERATIONAL AND INTERDISCIPLINARY. David MacInnes Chemistry Department, Guilford College, Greensboro, NC 27410

A novel, integrated chemistry laboratory course has been instituted at Guilford College which actively involves all chemistry students above the freshmen level. During the fall semester, students enrolled in analytical, organic or first semester physical chemistry all take this lab course which satifies the laboratory component of each of the three courses. For the first part of the semester students work to gain the basic skills associated with their particular disciplines of chemistry. The remainder of the semester is spent working in small groups on research problems which involve components of all three disciplines. Students are introduced to basic research, group dynamics, deadlines, the library and learning how to apply their own skills and training to complete a project. The syllabus and both student and faculty response to the course will be presented.

359 SPREAD SHEETS IN THE QUANTITATIVE ANALYSIS LABORATORY. Albert Schlueter, Department of Chemistry, Central State University, Wilberforce, Ohio 45384

This year students in the quantiative analysis sequence at Central State University were required to do their data analysis for most experiments on a spreadsheet. The public domain 1-2-3 spreadsheet clone "Aseasyas" was used. The spreadsheet format for the class enabled many more experiments to be completed with a considerable gain of laboratory content. More laboratory techniques were developed and all students developed proficiency with the use of spreadsheets.

The course syllabus, experiment write-ups, examples of spreadsheet results and student instructions will be available to those interested.

360 COMPUTERS IN UNDERGRADUATE PHYSICAL CHEMISTRY. Mundiyath Venugopalan, Department of Chemistry, Western Illinois University, Macomb, IL 61455.

Several ways of introducing microcomputers into the undergraduate physical chemistry curriculum will be presented. The emphasis will be placed on how to approach problem solving with a computer. Programs covering the most important aspects in the computation of standard thermodynamic properties, equilibrium constants, and reaction rates from molecular properties of gases will be discussed.

361 DESIGNING NEW CHEMISTRY COURSES, CURRICULUM STRUCTURES, AND TEACHING STRATEGIES, K-12 -- FOR THE DECADE OF THE 1990's. Marjorie Gardner, Lawrence Hall of Science, University of California, Berkeley, CA 94720

362 ILLUSTRATING THE RUTHERFORD ALPHA PARTICLE SCATTERING EXPERIMENT WITH THE COMPUTER PROGRAM "ALPHA SCATTER". Frank W. Darrow, Department of Chemistry, Ithaca College, Ithaca, NY 14850.

Computer illustrations can point out and emphasize key ideas. The Rutherford experiment in alpha particle scattering by a thin metal foil was fundamental in developing the idea of a nuclear atom. The program "Alpha Scatter" (Rittenhouse, Robert C. *JCE: Software 1988, 1A*(1), 25) first illustrates the experiment, showing through animation that most alpha particles pass through a foil but a few are deflected from small to very large angles, and then does the impossible experiment of blowing an atom up to full screen to illustrate the trajectory of individual alpha particles through it. If the program is combined with other classroom models then students develop a better understanding of this important key idea. Improved student learning is demonstrated through both anecdotal evidence and student scores on similarly worded examination questions with and without use of the program in course lectures.

363 USING A COLUMN CALCULATOR IN GENERAL CHEMISTRY LABORATORY. Steven Gammon, Gery Essenmacher, Department of Chemistry, University of Wisconsin-Madison, 1101 University Avenue, Madison, WI 53706.

The program *NOTEBOOK* (Robert C. Rittenhouse, private communication, submitted to *JCE: Software*) permits students to manipulate columns of numbers in the same way that they would handle individual numbers on a calculator. For example, columns can be added, subtracted, multiplied, or divided by other columns, logarithms and other functions can be applied to a column, one column can be plotted against another, etc. *NOTEBOOK* is like a spreadsheet, but simpler to learn and use for calculations of the kind done in general chemistry laboratories. We have used this program extensively in Chemistry 103, first-semester general chemistry, for students to analyze data from several experiments where large data sets can be generated. The graphing and linear regression features are particularly helpful, both for students and for teaching assistants who grade laboratory work.

364 GOING BEYOND THE GAME PADDLE PORT IN CHEMISTRY. Robert Alan Shaner, Department of Chemistry, South Side Area High School, Hookstown, Pa. 15050.

Over the years, experiments have been developed using the game paddle port. Now with the use of an interface board, new and exciting experiments can be done in chemistry. This presentation will look at experiments dealing with pH, gas chromatography, thermocouples, Hall Probes, and humidity sensors.

365 A SIMPLE COMPUTER-INTERFACED EQUILIBRIUM EXPERIMENT. Teresa Anderson, Steven Gammon, Gery Essenmacher, Department of Chemistry, University of Wisconsin-Madison, 1101 University Avenue, Madison, WI 53706.

We have introduced into our general chemistry laboratory an experiment in which the equilibrium constant for the reaction between nitrogen dioxide and dinitrogen tetroxide is measured at a series of temperatures. The experiment and an associated computer program were designed and developed elsewhere (D. Wahlstrom, M.S. Thesis, 1989, Eastern Michigan University, Ypsilanti, MI 48197). Use of the computer makes the experimental measurements relatively simple and greatly enhances the data analysis, which otherwise would entail more time than students could reasonably be expected to expend on a single experiment.

366

TEACHING CHEMISTRY: STRATEGIC CLUES FROM THE STRUCTURE OF KNOWLEDGE, Richard A. Duschl, Department of Instruction & Learning, University of Pittsburgh, Pittsburgh, PA 15260

Recent studies and analyses carried out by historians, philosophers, and sociologists of science have contributed to the development of a theory of instructional design divides content into three domains: concept based knowledge, procedure based knowledge, and principle or theory based knowledge. Each of these areas is an important element of teaching chemistry but I will focus on strategies for presenting the last of these - theory based knowledge. Research suggests that an instructional sequence which follows the historical development of theoretical knowledge is an effective elaboration strategy for teaching principles. The presentation shall use the development of the gas laws and the periodic table as the context for talking about strategic knowledge guideslines in the teaching of chemistry.

367

THINKING CHEMISTRY, TALKING CHEMISTRY AND DOING CHEMISTRY: THE "CHEMISTRY" OF CHEMISTRY TEACHING AND LEARNING, Antonio Bettencourt, College of Education, Michigan State University, East Lansing, MI 48824-1034

Chemistry has been constituted as a science very recently. Its roots go, however, very far into human history. The "chemical" look was present in many cultures since the highest antiquity. Looking at the world chemically may mean: puzzle at transformation and permanence, look for irreducible units and maintain a sense of the whole (i.e. analyze), reorganize the world in totally novel ways (i.e. synthesize).

This paper argues that the construction of Chemistry in the chemistry classroom demands the making of this "chemical look". to reduce the scope of the analysis I will limit myself to three interrelated aspects of that construction: ideas, social interaction, and practical work. The paper will analyze the demands of understanding chemical ideas in terms of epistemological ruptures with common ways of seeing and thinking; how these demands are fabricated, negotiated, maintained and changed in a matrix of discourse that includes chemistry, social organization of the class with its micropolitics and other concurrent discourses; and finally how the practices of chemistry arises from the ideas and the discourse, challenges them, is constrained by them and helps make the ideas and the discourse. Examples from real and fictitious classrooms will be used throughout to clarify the issues.

The paper concludes with a brief overview of the implication of a richer view of chemistry teaching and learning for classroom practice and science education research.

368 PROBLEM SOLVING IN CHEMISTRY AND EDUCATION: PSYCHOLOGICAL AND SOCIOLOGICAL ASPECTS. Craig W. Bowen, Science Education, Florida State University, Tallahassee, Florida 32306.

Problem solving -- doing something when you don't know what to do -- has interested chemical educators for some time. This session focusses on three areas of problem-solving related to chemical education. First, a model is given describing how people solve problems in chemistry. The importance is not so much on the content (i.e., organic synthesis), but on problem solving processes people use. By understanding these processes we can help students, and ourselves, become better problem solvers. Next, the teaching of chemistry is conceptualized as a problem-solving activity. By thinking of teaching as problem solving, and using a model of problem solving as a heuristic, we can continue improving our own teaching. Finally, in order to extend this model, current research is presented that examines cultural effects on problem solving and their relationships to learning and teaching chemistry.

369

HIGH SCHOOL CHEMISTRY: REASONS UNDERLYING TEACHERS' CLASSROOM PRACTICES, James J. Gallagher, Michigan State University, East Lansing, MI 48824-1034, Thomas Yocum, Pinckney High School, Pinckney, MI, Ruthann Schulke, Pinckney High School, Pinckney, MI

This is the study of the first three years of a beginning chemistry teacher's career. The authors explore the difficulties that are faced by the new teacher as she attempted to transform her formal knowledge of chemistry and pedagogy into the practical work of a high school chemistry teacher. The report will include the teacher's difficulties in gaining and maintaining classroom control; in organizing, planning, and conducting lessons; and in dealing with the constraints that were placed on her by the school officials, her peers, and expectancies from students and parents.

The report will examine curricular expectancies in high school chemistry including the dominance of the test and tests, the mixed signals from peers and district officials which beginning teachers must clarify, and the sources of support that are available to assist new teachers in early stages of their professional development.

370

ALTERNATIVE ASSESSMENT IN SCIENCE EDUCATION, Anthony Lorsbach, Florida State University, Tallahassee, FL 32306

In the current science education reform movement in the United States alternative assessments are at center stage. Science educators see alternative assessments as one way to change the "facts-oriented" curricula that is characteristic of most school science programs. Educators assume that alternative assessment tasks will be used by teachers in the manner intended, but our research shows that teachers personal epistemologies, beliefs, and values are the primary influences of what teachers do in the classroom, including assessment. Our findings suggest that teachers will not use alternative assessments in the manner intended. Teachers who value technical interests and make sense of what they do from realist perspective will probably change the focus of assessment tasks to obtain products and assign grades that reflect their values and local educators where to adopt a policy of teachers using alternative assessments techniques to change school science curricula.

371

ENHANCING THE QUALITY OF SCIENCE LEARNING AND TEACHING

Kenneth Tobin
Florida State University
Tallahassee, FL 32306

If the quality of science learning is to improve, teachers must bear the burden of change. Research in science education provides insights into new approaches for the design and implementation of programs which maximize the chances that improved learning environments can be sustained in science classes. Three essential requisites for change are for teachers to develop a commitment to change, construct a personalized vision of what a science curriculum could be like, and to reflect on their thoughts and practices. Rather than reflecting on practices only, as many recent approaches to teacher enhancement advocate, it is important for teachers to reflect on their images, metaphors, values, and beliefs. The presentation will discuss research on the cognitive and structural aspects of teacher change, and the importance of teachers adopting new roles such as being a mentor to their colleagues and a researcher in their own classes.

372 **CHEMISTRY IN THE TOY STORE**, David A. Katz, Department of Chemistry, Community College of Philadelphia, 1700 Spring Garden Street, Philadelphia, PA 19130.

The chemistry of everyday materials can be an interesting and fascinating topic. One can usually find information on how chemistry affects our everyday lives in the form of consumer items that would be used in the kitchen, laundry, boudoir, workshop, garden, and place of work. One place that has gained popularity, in recent years, is the toy store. Toys have been an area where chemical items are common, not just in the materials that playthings are composed of, but many playthings themselves involve chemicals, chemical reactions, or the unique properties of a particular material. Whether it is a chemistry set, a silicone putty, a polymer with unusual properties, a material to make or mold another plaything, liquid crystals, memory metals, or the batteries used to power mechanical or electronic items, the toy store is a unique place for chemical products.

This presentation will examine a range of chemical toys, demonstrate how they work, how some are made, and discuss how they can be used in the classroom and laboratory to provide introductions and examples to lecture topics, as well as, to provide interest and excitement in the course.

373 **Using Cricket Graph for Analysis of Laboratory and Classroom Data**
Diana Malone Dept. of Chemistry, Clarke College, Dubuque IA 52001

Cricket Graph is a high-performance data analysis program which can be used to analyze data generated in the laboratory and to illustrate lecture material. This powerful software includes:

1. Choice of a variety of graph styles, including multiple plots on the same graph,
2. Regression and derivative analyses,
3. Data transformations: Ln, Log, e^x, X^n, Sin(x), Cos(x), running sum and Z-score.

The graphs produced allow the user to set axis range, label axes and plots, and add text to the plot.
The demonstration will include: derivative analysis of titration data, regression analysis of spectrophotometric data, analysis of kinetic data, and other uses of this software.

374

INTERFACED EXPERIMENTS IN A GENERAL CHEMISTRY LAB WITH ONE MACINTOSH SE
by Annamaria Fulep-Poszmik and Sally Solomon
Drexel University, Chemistry Department
32nd and Chestnut St
Philadelphia, PA 19104

The use of a Macintosh SE to collect spectroscopic data is demonstrated by performing a kinetics experiment. Hardware requirements include a Macintosh SE/20 and a commercially available interfacing board. The accompanying software is so easy to use that students will be free to concentrate on the chemical measurement. The data, collected in the form of a text file, can be treated using standard spreadsheet and plotting programs. Strategies are suggested to allow maximum student participation using just one computer set up per laboratory classroom.

375 COMPUTER ANALYSIS OF LABORATORY DATA BY FRESHMAN CHEMISTRY STUDENTS.
C. A. Baker, Department of Chemistry, Butler University, Indianapolis, Indiana 46208.

Traditional laboratory programs for high school and freshman college level chemistry require a student to perform a single trial, or a very limited number of trials, for an experiment and report the results as though they constituted a completed "experiment." In reality, this is not the way real science works and often misleads beginning students as to the structure of science. In order to address this problem, two levels of freshman chemistry students at Butler University have been submitting class data sets to simple statistical analysis. One group was an honors group of principally chemistry majors, the other a group of non-science majors. We used "Multistat" on a Macintosh IICX computer. Students entered data, ran the program, and analyzed results. This presentation will include details of the statistics used, results of student work, and suggestions for using the procedure on other computer systems and with other software packages.

376 IR/NMR SPECTROSCOPY, Kathryn Stone Bailey, The Paideia School, 1509 Ponce de Leon Avenue NE, Atlanta, GA 30307

Computer software can be used to demonstrate a variety of laboratory situations not readily available in the classroom. IR & NMR SPECTROSCOPY published by Falcon Software, provides tutorials and spectra for interpretation that can be effectively used by high school and college students.

377 HELPING STUDENTS MASTER THE SIX-SOLUTION PROBLEM. Helen M. Stone, Ben L. Smith High School, 2407 South Holden Road, Greensboro, NC 27407.

Most beginning chemistry students need major help solving Jerry Bell's *Six Solution Problem*. (Seraphim AP 902) First, they need to understand WHY 15 tests are needed to check all possible combinations. Second, they need a 15-box grid (which I provide) to SYSTEMATICALLY record test results. Third, they identify the ions, knowing that: the silver solution forms 3 ppts (1 white, 2 yellow); the chloride solution forms 1 white ppt; the bromide 1 yellow ppt; the carbonate 1 yellow ppt plus bubbles with the acid solution; and the water shows no reaction. Students who use this organized approach are excited by understanding the answers. Without such organization, students run out of solution, lose track of data, and lose interest in solving the problem.

378 MOLE DEMO II, A NEW AND MUCH IMPROVED VERSION OF AN OLD FAVORITE. Lee R. Marek, Naperville North H. S., 899 N. Mill St., Naperville, IL, 60563

The mole concept has caused students' problems for years. Wilhelm Ostwald used the term mole which comes from Latin meaning "little heaping pile". (This is what many students think of this concept!) Part one of this program shows the effect of stacking one mole ($6.02 * 10^{23}$) sheets of paper from Earth to Pluto. Part II shows the paper stacked from Pluto out to 4600 light years (one complete mole) away. This is a much improved version of the original MOLE DEMO I gave to SERAPHIM 6 years ago. There is a "sound track" [ever Star Trek] and nice high res. graphics throughout. This is done by high school students and is public domain.

379 ILLUSTRATING THE RUTHERFORD ALPHA PARTICLE SCATTERING EXPERIMENT WITH THE COMPUTER PROGRAM "ALPHA SCATTER". Frank W. Darrow, Department of Chemistry, Ithaca College, Ithaca, NY 14850.

Computer illustration can point out and emphasize key ideas. The Rutherford experiment in alpha particle scattering by a thin metal foil was fundamental in developing the idea of the nuclear atom. The program "Alpha Scatter" (Rittenhouse, Robert C. J. Chem. Ed.: Software 1988, 1A(1),25) first illustrates the experiment, showing through animation that most alpha particles pass through foil but a few are deflected from small to very large angles, and then does the impossible experiment of blowing an atom up to full screen to illustrate the trajectory of individual alpha particles through it. If the program is combined with other classroom models then students develop a better understanding of this important key idea. Improved student learning is demonstrated through both anecdotal evidence and student scores on similarly worded examination questions with and without use of the program in course lectures.

380 PERIODIC TABLEWORKS AND OTHER ONE-COMPUTER CLASSROOM GEMS. T. Y. Susskind, Department of Natural Science, Oakland Community College, Auburn Hills, MI 48057.

July, 1990 marks the second anniversary of the first issue (Volume 1A, Number 1) of the Journal of Chemical Education: Software. Prepared for Apple II computers, the first issue was designed for the teacher who wishes to demonstrate chemical principles to an entire class with just one computer. The volume includes five demonstration programs on atomic structure and the periodic table. They include: Alpha Scatter, Wave, Sum of Two Waves, Aufbau and Periodic TableWorks. Periodic TableWorks converts the Apple II computer into an electronic periodic table. It highlights elements, groups or periods; it then displays states, data, or trends of selected properties. The use of the programs in JCE: Software, Volume 1A, Number 1, will be demonstrated.

381 ONE COMPUTER CLASSROOM - CHEMISTRY, ENVIRONMENTAL AND PHYSICS Patricia C. Flath, Paul Smith's College, Box 45, Paul Smiths, NY12970

One computer does not prevent a teacher from doing very creative classroom teaching. At Paul Smith's College, we use one computer classroom type demonstrations in calculus-based Physics, general, organic and environmental chemistry courses.

This presentation will demonstrate various software programs which have been of particular value to our faculty and students, including a physics timing program, a comprehensive data-base program of limnological data and several simulation programs (of laboratory instruments), including a HPLC and GC.

382 SEEING THE STARS: THEN AND NOW. U. Lee Barnwell, Jr. Science Department, Tri-County Technical College, Pendleton, SC 29670

Once man's knowledge of the universe was collected by the unaided eye as he observed it in the very narrow band of the electromagnetic spectrum which we have labeled visible light. Now, man has expanded his knowledge as he views the universe using the much wider band of the electromagnetic spectrum we have labeled radio. This brief introduction to astronomy will attempt to prepare the audience for presentations on Cosmic Chemistry that will follow.

ELECTROMAGNETIC TECHNIQUES FOR CHARACTERIZATION OF PLANETARY ATMOSPHERIC CONSTITUENTS

Paul G. Steffes (School of Electrical Engineering, Georgia Institute of Technology, Atlanta, GA 30332-0250)

A large number of techniques have been developed for the characterization of the nature and abundance of planetary atmospheric constituents. While in situ probes have characterized the atmospheres of Mars, Venus, (and soon Jupiter) at selected specific locations, the majority of our knowledge regarding planetary atmospheres has come from electromagnetic remote sensing techniques, including passive spectroscopy of natural atmospheric emissions and bistatic radar. This paper considers the broad range of electromagnetic techniques operating at wavelengths from radio to ultraviolet, and compares their capabilities and results with in situ techniques. Several current issues regarding gaseous constituent identification in neutral atmospheres will be discussed.

384 MOLECULES IN INTERSTELLAR SPACE. M.M. Graff, School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332-0430.

The chemistry of interstellar clouds can be largely understood by simple models and simple guidelines. Diffuse interstellar clouds are characterized by low temperatures (T~50 K), low number densities (n~10^3 cm^{-3}), and a chemistry that is mediated by a relatively high photon flux. Constituents are predominantly atomic and molecular hydrogen, with lower abundances of simple atoms (He, O, C, C^+, N) and molecules (HD, CO, OH, CH, CH^+). Dense clouds are colder (T~10 K) with densities somewhat higher (n~10^3-10^5 cm^{-3}); their opacity inhibits most photoprocesses. The gas is primarily molecular hydrogen with minor constituents of simple oxygen and carbon species (O, CO, OH, H_2O, O_2), but a bewildering variety of complex molecules is also present. Despite the apparent simplicity of interstellar cloud chemistry, important discrepancies persist between the observations (now quite extensive) and the chemical models (now quite sophisticated). Resolutions may involve shock-heated regions, nonthermal chemistry, surface chemistry on grains, or cloud dynamics. Here we will describe simple models of cloud chemistry and the remaining challenges for future work.

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LABORATORY EXPERIMENTS AND COMETARY SCIENCE. R. L. Hudson, Collegium of Natural Sciences, Eckerd College, St. Petersburg, FL 33733.

Each year about a dozen comets are detected passing around the sun. Since comets are thought to have been formed about 4.5 billion years ago, and since they have remained frozen in space since, they provide important and interesting information about early solar system conditions. The study of cometary composition and chemistry has become essential to a complete understanding of cosmochemistry. This talk will begin by reviewing accepted theories of cometary structure and composition. The majority of the presentation will concern how laboratory experiments, often by chemists, have helped build and test models of cometary chemistry. Included among the work to be presented are matrix isolation, radiolysis, and mass spectral experiments.

386 COSMOCHEMISTRY AND THE ORIGIN OF LIFE: MILLER-UREY REVISITED. C.N. Matthews, Dept. of Chemistry, University of Illinois at Chicago, Chicago, IL 60680

How did life on Earth begin? How were proteins and nucleic acids originally synthesized? Following the pioneering demonstration by Miller and Urey that a-amino acids are readily obtained from methane, ammonia and water subjected to electric discharges, it has become widely accepted that the prebiotic formation of polypeptides occurred in two stages, a-amino acid synthesis initiated by the action of natural high energy sources on the components of a reducing atmosphere, followed somehow by condensation of the accumulated monomers in the oceans or on land. Critical examination of the evidence for this view, however, shows that the inherent thermodynamic barrier to spontaneous polymerization of a-amino acids might not have been so readily overcome.

An alternate hypothesis bypasses this problem by postulating the direct synthesis of primitive proteins from hydrogen cyanide polymers and water without the intervening formation of a-amino acids Continuing investigations suggest that these HCN polymers can account not only for the past synthesis of protein ancestors and other macromolecules on Earth but also for reactions proceeding elsewhere today within our solar system and beyond.

387 CHEMISTRY AND THE "FINAL FRONTIER". David J. Crouse, Department of Chemistry, Tennessee Technological University, Cookeville, TN 38505, and Paul B. Kelter, Senior Scientist, University of Wisconsin Oshkosh, Oshkosh, WI 54901.

This presentation will examine ways in which topics from the space sciences can be incorporated into the classroom. Recent developments in planetary exploration can provide dynamic examples of fundamental chemistry. Also included will be examples of chemical applications in the technology of space exploration.

388 **CHEMISTRY IN SCIENCE MUSEUMS.** David A. Ucko, President, Kansas City Museum, 3218 Gladstone Boulevard, Kansas City, MO 64113

Science museums have used exhibits, demonstrations, and other techniques to present chemistry to the public for many years. These presentations have been designed to provide experiences unavailable either in the schools or the home. The content presented by these means range from simple chemical "magic" to the more sophisticated social impact of chemical technology. The strengths and weaknesses of these approaches, as well as their constraints and limitations, will be analyzed. Ways to enhance science museum visits through links to formal education also will be discussed.

389 HANDS-ON CHEMISTRY AT A SCIENCE MUSEUM. Dennis Drobeck, Impression 5 Science Museum, 200 Museum Drive, Lansing, Michigan 48933

Chemistry is a science that has had a major impact on the lives of everyone in America. Despite this, it is generally overlooked in the schools and public media. Changing the public's perception and student's knowledge and interest of chemistry will be a major challenge as we work towards improving science education in America. One way of accomplishing this is to develop chemistry programs in conjunction with a science museum. Impression 5 is a facility that has worked towards overcoming some of these difficulties. A large and diverse number of programs have now developed to encourage and excite students to investigate chemistry, teach chemistry, change the public's perception of chemistry and help teachers incorporate hands-on chemistry into their curriculum. The discussion will include information on these programs and give details of the lab's operation as well as possible methods for developing similar projects at other museums.

390

TAKING THE MYSTERY OUT OF CHEMISTRY

COSI, Ohio's Center Of Science & Industry has developed an exciting, hands-on exhibition on chemistry. The centerpiece of the exhibition is a high-tech demonstration stage devoted to the presentation of informative, thought-provoking and entertaining chemistry demonstrations.
Over 700,000 annual visitors experience the exhibit and leave with an increased awareness of this important science, particularly the often unseen impact it has on their daily lives.
This slide presentation will be a walk through the exhibition with an examination of the exhibit's objectives and components.

391 AMERICAN CHEMICAL SOCIETY PURSUITS IN CHEMISTRY FOR MUSEUMS. R. E. Leber, Smithsonian Fellow, ACS Communications, American Chemical Society, 1155 16th Street, N.W. Washington, D.C. 20036

Recently, the American Chemical Society has initiated several activities attempting to improve public understanding of the basic and applied chemical sciences through the informal education environment of museums. This paper will present the latest information on those various initiatives: "Molecules and Society" (a multi-media show produced by the Cite des Sciences et de l'Industrie in Paris, France), "Science in American Life" (a partnership between the American Chemical Society and the Smithsonian Institution's National Museum of American History), and an expanding network of individuals and institutions here and abroad engaged in efforts to improve the extent and quality of exhibits addressing the chemical sciences and technologies.

392 ENHANCING PUBLIC UNDERSTANDING OF SCIENCE WITH PING-PONG ROCKET, CRYSTAL SPIDER, AND OTHER HANDS-ON CHEMISTRY EXHIBITS. Suzanne Ullensvang and Ilan Chabay, The New Curiosity Shop, Inc. 1924 - B Old Middlefield Way, Mountain View, CA 94043

We have created a set of interactive chemistry exhibits for public display and demonstration in science museums and other venues. Most of the exhibits were developed through prototype and testing stages under contract with the California Museum of Science and Industry and funded by NSF. These exhibits, several of which will be demonstrated, are designed to make aspects of chemistry exciting and accessible to an audience of all ages and levels of scientific sophistication. Equilibrium, crystal growth, nucleation, heats of reaction, stoichiometry, chemical analysis (spectroscopy, chromatography, pH, solubility in water, reaction with iodine), polymerization, and a molecular dynamics simulator are included in the set of exhibits. Important molecular phenomena are illustrated and, when used together as a cluster of related experiences, can help develop a conceptual framework with which to understand chemistry.

393 ARTIFICIAL INTELLIGENCE - WHAT IT IS AND ISN'T, Arthur A. Eggert, A4/2204 Clinical Sciences Center, 600 Highland Avenue, University of Wisconsin-Madison, Madison, Wisconsin 537922

The term "artificial intelligence" (AI) today evokes the same type of mysterious foreboding that the terms "digital computer" and "electronic brain" may have a few generations back. The very existence of AI calls into question any long-held beliefs in the superiority of human wisdom. But what is artificial intelligence? Who conceived it and what has it accomplished thus far? And what might AI do in the future: outthink us, solve all our problems, enslave us, ... or even make us obsolete? All these are reasonable questions, and the answers are at the same time both reassuring and alarming.

Chemistry was an early area of AI activity, and some of the more recent work relates to chemical education. What can AI do for chemistry and chemical education? This presentation will attempt to answer this, giving a historical overview of AI, providing references and highlighting points of controversy.

394 HOW DO YOU "MODEL" A STUDENT? Elizabeth Kean, Center for Science, Mathematics and Computer Education, University of Nebraska, Lincoln, Nebraska 68588-0355

When a human tutor works with a student, many different types of communication are exchanged. The tutor remembers parts of these exchanges and uses them to make decisions about future work with the student. A computer tutor, however, has access to a different type of information -- the student's keystrokes made through time. The computer tutor needs to remember some (but not all) of the information that these keystrokes contain and then build a student model to use as a data base for future decisions.

In this paper, the authors of CHMEPROF, an intelligent tutor for general chemistry, will discuss how its student model was built and the insights that arose in the process of building it.

395 KC EXPERT AND KC TUTOR: A NATURAL LANGUAGE INTERFACE TO A CHEMICAL DATABASE PLUS AN INTELLIGENT TUTOR, W.F. Coleman, Wellesley College, Wellesley, WA, and G.S. Owen, Georgia State University, Atlanta, GA 30303.

In this presentation we will discuss the classroom useage of KC Expert and KC Tutor. KC Expert is an expert system with knowledge about the chemical elements; it uses the same elemental database as KC Discoverer (developed by Project SERAPHIM) as well as some added rules extending its knowledge of chemistry. KC Expert has a natural language interface which allows the user to query the system in English and to receive English responses. KC Tutor extends this in that the students may enter a tutor mode wherein KC Tutor does not just give the answer to the student but assists the student in solving the problem.

396 WHAT'S IN A NAME? TWO EXPERTS FOR CHEMICAL LITERACY
Arthur A. Eggert and Catherine Middlecamp
University of Wisconsin-Madison, Madison, WI 53706

To permit CHEMPROF, an intelligent tutoring system, to help students learn how to name and write formulas for inorganic compounds, two expert systems were developed: one to convert names to formulas and one to convert formulas to names. These experts not only provide the correct name or formula, but also produce a systematic trace of the solution steps that CHEMPROF can then use to select an appropriate teaching method for the student. Wherever possible, the experts use chemical principles to establish the name or formula of a chemical rather than resorting to table look-up.

Not unexpectedly, in creating these experts, a number of pitfalls were encountered. Some of these were due to the subtleties and inconsistencies of chemical nomenclature. Others arose from the need of the input routines to screen for entries that were not chemically feasible or were "organic". These pitfalls will be discussed, providing insights relevant to the utility of AI systems and to the teaching of basic literacy skills in chemistry.

397 DEVELOPMENT OF AN EXPERT SYSTEM. James P. Birk, Department of Chemistry, Arizona State University, Tempe, AZ 85287-1604.

A critical component of an intelligent tutoring system is the expert system, which contains the rules and facts that govern the subject matter. Development of an expert system requires an understanding of the functioning and thinking patterns of a human expert; such understanding often eludes even that expert. We will describe our experiences in developing expert systems on chemical reactivity, including methods of collecting expert information. An instructional expert system must incorporate not only the expertise associated with a subject area, but also sound pedagogy. An expert system designed in this way can then be inverted to explain its responses to requests for information or predictions.

The development of an expert system can lead to a better understanding of the methodology of the subject area. In particular, limitations and deficiencies in teaching methodology are revealed by attempts to teach the subject matter to the computer.

398 BUILD YOUR OWN EXPERT SYSTEM? Frank A. Settle, Jr., Department of Chemistry, Virginia Military Institute, Lexington, VA 24450.

A number of relatively inexpensive ($100 to $500) but powerful expert system development tools are currently available for use with personal computers. It is now possible for an instructor with minimal background in expert systems to develop small to medium sized educational systems focused on specific areas of the chemistry curriculum. The process of selecting a suitable shell and developing an expert system will be presented. Several applications will be discussed to illustrate the capabilities and limitations of expert systems in chemical education. The desirable features for a development tool will be listed and several popular commercial shells will be reviewed.

399 PROJECT INTERACTION: AN EFFECTIVE MODEL FOR THE CONTINUING EDUCATION OF HIGH SCHOOL CHEMISTRY TEACHERS. Daniel J. Antion, University of South Carolina, Columbia, South Carolina, 29208 and Sondra F. Wieland, Fort Mill High School, Fort Mill, South Carolina, 29715.

Project Interaction is an intensive, five-week continuing education institute for South Carolina High School Chemistry Teachers that employs a unique Learning-Teaching Cycle to improve knowledge and understanding of chemical principles. The Learning-Teaching Cycle lowers fear barriers, raises confidence levels, enhances teaching effectiveness, and promotes professional development of chemistry teachers. Details of the NSF co-sponsored project will be discussed and measures of teacher performance and progress will be presented.

400 COLLEGE FACULTY CAN INFLUENCE HIGH SCHOOL CHEMICAL EDUCATION -- THE MISSISSIPPI EXPERIENCE. John H. Bedenbaugh and Angela O. Bedenbaugh, Department of Chemistry and Biochemistry, Box 8466 University of Southern Mississippi, Hattiesburg, MS 39406-8466

The Education Committee of the Mississippi Section of the ACS is comprised of a concerned group of college faculty members and high school teachers who have been working for six years to improve the quality of high school chemical education in Mississippi. The Committee has designed and implemented a workshop curriculum to reinforce and enhance the chemical knowledge of high school chemistry teachers whose educational background is in a science other than chemistry. Beginning in 1988 a total of 160 commuting teachers at eight locations in the state have participated in the six-week workshop and follow-up activities conducted by two-person teams (a college-level chemistry teacher and a star high school chemistry teacher). Our presentation will include unique features of this approach to teacher enhancement, efforts to institutionalize the program on a statewide basis, and the planned evolution of the workshop program into an in-service instructional program in chemistry to be offered through intrastate regional associations of high school chemistry teachers which are now being organized.

401 HELPING HIGH SCHOOL STUDENTS BY UPDATING THEIR TEACHERS. Alan J. Pribula, Nordulf W. G. Debye, and Frank R. Milio, Department of Chemistry, Towson State University, Baltimore, MD 21204.

Our department, at the request of and in conjunction with the Office of Science of the Baltimore County Public School System, has developed a course sequence designed to upgrade the Chemistry backgrounds of secondary school teachers currently certified in other science areas. This will help to offset a local shortage of certified Chemistry teachers projected for the next few years. The High School Chemistry Teacher Enhancement Program consists of seven content-oriented courses in General, Physical, Organic, and Biochemistry, as well as in Chemical Measurements and Instrumental Methods. Most of the courses include both lecture and laboratory components. We are now roughly halfway through this program, with about 30 teacher-students having participated thus far. This paper will present information about the overall program, the individual courses, the student participants, and general information about the administration of the program.

402 BRIDGING THE GAP BETWEEN SECONDARY SCHOOLS AND COLLEGE: THE MILLSAPS COLLEGE-HHMI CO-SPONSORED SUMMER RESEARCH INSTITUTE. Johnnie-Marie Whitfield, C. Eugene Cain, Department of Chemistry, Millsaps College, Jackson, MS 39210.

The second Summer Research Institute (SRI) has just been completed at Millsaps. This unique month long program is in the second of a five year joint project between Millsaps and the Howard Hughes Medical Institute (HHMI). In Phase I, a small group of high school teachers worked intensely with Millsaps faculty members covering the research tools that could be utilized in Phase II when talented high school students arrived on campus. Participants worked in a networked computer environment, with new microscale lab techniques, and with modern instrumentation such as FTIR, GC-MS, NMR, and AA. Research teams were formed for Phase III when research projects were begun on campus and mini-grant proposals were submitted for additional support of the project throughout the coming academic year in Phase IV. As the participants were drawn primarily from the Jackson metropolitan area, Millsaps was able to offer support throughout the year. Presentation of results at a professional meeting was strongly encouraged.

403 A CHEMISTRY/PHYSICS COURSE FOR THE PREPARATION OF MIDDLE SCHOOL SCIENCE TEACHERS

S. McROBBIE AND N. ZEVOS POTSDAM COLLEGE POTSDAM, N.Y. 13676

Potsdam College was one of nine institutions in the United Sates selected by NSF to develop a mathematics science teacher program for the preparation of middle school teachers. The program is the combined effort of the school of education and the school of liberal studies. An overview of the entire program will be given but the presentation will focus on the integrated Chemistry/Physics course that was developed for the program. The course content and the laboratory experiments associated with this course will be discussed. The relationship between the Chemistry/Physics course and the integrated Biology/Geology will be presented.

404

THE USE OF COMPUTERS IN A BEGINNING CHEMISTRY LABORATORY. Nicholas Zevos and Bruce N. Campbell, Jr., SUNY Potsdam, Potsdam, NY 13676.

A specialized course of limited enrollment which integrates Chemistry and Physics for future Middle School science teachers (funded by the National Science Foundation) has been developed by the first author with others. One of the goals of this course was to integrate the use of computers. A number of approaches and experiments have been tried. These will be described in some detail as well as problems that needed to be addressed.

405 TRAVELING CHEMISTRY DEMONSTRATIONS -- MORE THAN MEETS THE EYE. R. I. Perkins, Greenwich High School, Greenwhich, CT 06830

A number of popular NEAT, WOW, SUPER chemical demonstrations will be presented. This will be followed by a detailed analysis of the techniques used: the beginning, selection, sequence, connections, safety, ending. Although each traveling chemical demonstrator soon develops a personal style for presentation, there are many hidden "tricks of the trade" which can help the more inexperienced traveling demonstrator.

406 **ADDING ORGANIC AND BIOCHEMISTRY TO INTRODUCTORY COURSES** Jerry A. Bell Department of Chemistry, Simmons College, Boston, MA 02115

The subtitle of this presentation might be, "What Is So 'General' About General Chemistry?" By "general chemistry," I mean the high school and college courses that students take to be introduced to this wonderfully diverse area of human endeavor. Textbooks are probably reasonably representative of what is being included in these courses and the approximate proportion of each topic. By this standard, most chemistry would seem to be that of aqueous solutions and inorganic ions. Organic and biochemistry are relegated to a chapter or two each and often seen to b an afterthought. Reactions in solvents other than water are rarely mentioned. These courses give students a distorted view of chemistry. Is it any wonder that many leave their introductory course unconvinced that chemistry ever has or will touch their lives? I will try to demonstrate how our courses can be broadened to include these topics without giving short shrift to any of the principles we all think are important, *e.g.*, equilibrium, including acid-base and solubility.

407 SCIENCE IN A SUITCASE. V.R. Wilcox, Museum of Science, Science Park, Boston, MA 02114

Many of us are quite comfortable doing complicated, often messy and smelly, demonstrations in our own facility. There, the supplies, audience sightlines, audiovisual and safety equipment, and the support system, with whatever shortcomings, are at least familiar. But what happens to our program on the road, where many of these things are not predictable? We have to ask such questions as: (1) Can I carry it, and do I really want to if I have three programs in three locations that day? (2) Will it fit and store safely in my car? (3) If I have to fly, will I be subject to strip-search and detention while they find out that the white powder really is baking soda? This paper presents the KISS -- Keep It Safe and Simple -- approach to science on the road.

408 ADMINISTRATION DETAILS OF THE TRAVELING CHEMISTRY DEMONSTRATION PRESENTATION. Thomas J. Greenbowe, Department of Chemistry, Iowa State University, Ames, IA 50011 and William L.Dills, Jr. and James A. Golen, Department of Chemistry, Southeastern Massachusetts University, North Dartmouth, MA 02747.

Our discussion will deal with the administrative details associated with doing a traveling chemistry demonstration presentation for middle school or high school convocations or assembly programs of 250 students or more. We will provide information and suggestions as to what you should consider doing prior, during and after your demonstration presentation visit to a school. Our experience has taught us to put our expectations and requirements in writing to the school administration, before we agree to do a presentation at a school. Our "contract" letter explains the show in general terms and helps the teachers prepare their students, specifies the space and time requirements for the presentation, and outlines the terms and safety requirements. Safety is always our prime concern. We adhere to the ACS safety guidelines on chemical lecture demonstrations. Suggestions for a safe presentation include: working in pairs, using undergraduate chemistry majors as assistants, using rolling carts in order to have only one demonstration in front of the audience at a time, using a separate, private room to prepare, test, clean-up and dealing with disposal of waste products. ACS brochures and information on chemical careers and chemical education projects should be available to hand out to students and teachers.

409 CHEMICAL EQUILIBRIUM REVISITED-TO MINSQ OR NOT TO MINSQ. Clare T. Furse, Department of Chemistry, Mercer University, Macon, Georgia 31207.

In general chemistry, acid-base and solubility equilibria are generally solved by using the simplest approaches. However, the determination of equilibrium constants from titration data are not amendable to these simple approaches. The fitting of titration data to a theoretical titration curve requires solving simultaneous multi-equilibria. The commercially available program called MINSQ (available from Micro Math) has been very useful in solving and fitting experiment titration data. Some examples will be illustrated. They will include: 1) the titration of a mono-protic acid, 2) the titration of a tri-protic acid, and 3) the potentiometric titration of a mixture of Cl^- and I^- ions.

410

CALCULATIONS FOR PERCENTAGE COMPOSITION OF A MIXTURE USING AN APPLE II COMPUTER, R. D. Ford, Chemistry Department, McLennan Community College, Waco, TX 76708

An Apple II computer program has been written and is being used by students in Introductory Chemistry Lab to perform the calculations which accompany an exercise involving percentage composition of potassium chlorate in a mixture of potassium chlorate and sodium chloride. The program uses the three weighings made by the student and performs and reports a series of calculations leading to weight-percent and to mole-percent values for the mixture.

411 INTEGRATING DESCRIPTIVE CHEMISTRY INTO THE HIGH SCHOOL CHEMISTRY CURRICULUM. Mundiyath Venugopalan, Department of Chemistry, Western Illinois University, Macomb, IL 61455.

Presentation of descriptive material in appropriate format is a continuing problem confronting the teaching of a beginning chemistry course. The problem has been discussed at meetings and symposia dealing with college chemistry and blamed, at least partly, on available textbooks. This paper will present the results of a workshop for high school teachers, which focused on some descriptive chemistry to develop the important theories and principles in high school chemistry.

412

A REPORT ON CHEMISTRY ACTIVITIES AT THE NATIONAL SCIENCE OLYMPIAD TOURNAMENT, May 18-19, 1990. C.L. Bering, S. Zamzow, W. Krugh, G. Wollaston, and F. Keen, Department of Chemistry, Clarion University of PA, Clarion, PA 16214

The 1990 National Science Olympiad Tournament was held at Clarion University of Pennsylvania on May 18-19. Chemistry-related events included Chemistry Lab and Periodic Table Quiz. A summary of these and other events will be presented.

413

THE NORTH LOUISIANA SCIENCE IMPROVEMENT PROJECT; William C. Deese, Department of Chemistry and Carolyn Talton, Department of Teacher Education, Louisiana Tech University, Ruston, Louisiana 71272.

"The North Louisiana Science Improvement Proposal; A Certification Inservice Project", funded by the National Science Foundation, was recently conducted. The primary objectives were to: 1) increase the number of certified high school chemistry teachers in north Louisiana, 2) provide inservice programs for the enhancement of chemical education in the area, and 3) establish a chemical education resource center. Details of the course offerings, inservice programs, and resource center will be presented.

414 PREPARING MINORITY STUDENTS FOR SCIENCE CAREERS--A SUCCESS STORY. Albert Schlueter, Department of Chemistry, Central State University, Wilberforce, Ohio 45384

Data will be presented on the chemistry majors graduating from Tougaloo College, Tougaloo, Mississippi in the period 1966 to 1970. The advanced degrees they achieved and their current positions in science and medicine will be reported. These data will be related to the significant projected needs for more minorities in the sciences in the future. Reasons for the success of these Tougaloo chemistry students will be explored and suggestions made for increasing the numbers of minority science majors.

415

ESTABLISHING LINKS BETWEEN HIGH SCHOOL AND PRE-HIGH SCHOOL SCIENCE TEACHERS THROUGH CHEMICAL DEMONSTRATIONS WORKSHOPS. Richard L. Petersen and Mark B. Freilich, Department of Chemistry, Memphis State University, Memphis, TN 38152.

A three week graduate credit course in chemical demonstrations for area high school and college teachers was run parallel to a demonstrations workshop for in-service pre-high school teachers. Each experienced chemistry teacher was paired with two elementary teachers and encouraged to share his expertise and establish collaborations for the coming school year. The chemistry teachers prepared and modified chemistry demonstrations suitable for their own classrooms. The workshop teachers practiced demonstrations based on the ICE "Chemistry Supplements" program. Both courses were offered in conjunction with a one week Kids Chemistry Camp laboratory program for rising 6th, 7th and 8th graders. Half the Kids Camp students attended on "scholarships" which we made available to local science teachers to award to deserving and motivated youth. Workshop and graduate course participants prepared pre-laboratory demonstration shows and supervised the Camp's laboratory experiences. A follow up study on the collaborative links between the high school and the pre-high school teachers is scheduled for December. *[Partially supported by ICE, Dwight D. Eisenhower, and Project 30 grants.]*

416 JHSci-TRAINING FOR MIDDLE SCHOOL SCIENCE TEACHERS. David J. Crouse, Department of Chemistry, Margaret Phelps, Linda McGugin, Department of Curriculum and Instruction, and Jerry Ayers, College of Education, Tennessee Technological University, Cookeville, TN 38505.

For the past two years the Colleges of Arts & Sciences and Education at TTU have conducted an interdisciplinary workshop for science and math teachers of Grades 6-9 in the Upper Cumberland. Many teachers at this level have minimal certification in the science areas they are currently teaching. The course integrated the science content prescribed by the state with activities desgned to enhance student interest and comprehension. The course was taught by a team of faculty drawn from both science and education departments. Each session was activity-oriented and provided the participating teachers with ideas and materials to enable them to teach the prescribed content more effectively. The project was evaluated on several criteria, including how it contributed to the participants' knowledge and attitudes.

417

INDUSTRIAL USES OF CHEMISTRY: A PRE-COLLEGE TEACHER WORKSHOP, Arlyne M. Sarquis, Department of Chemistry, Miami University-Middletown, Middletown, OH 45042 and John P. Williams, Department of Chemistry, Miami University-Hamilton, Hamilton, OH 45011

In each of the past two academic years, seventy-two grade 4-12 teachers and science coordinators have participated in a successful industrial chemistry workshop. Sessions utilized lecture, laboratory, and discussion to illustrate general industrial chemistry concepts as well as the chemistry important to the six participating companies. For two days of each session, teams of college faculty, industrial scientists, and peer teachers instructed grade-level-specific groups about local chemical companies; one day was spent on-site at the corresponding company. Between sessions, participants tested one or more of the hands-on activities in their classrooms and developed final projects. The impact of this program is advanced by workshop graduates presenting intra-district in-services. The mechanics and evaluation results of this program will be presented. This work has been supported in part by the National Science Foundation, Ohio Board of Regents, Miami University, Cincinnati Section ACS, Ohio Chemical Council, and local chemical companies.

418 IMPROVING THE UNDERSTANDING OF CHEMISTRY BY UPDATING BONDING. Robert T. Sanderson, 4725 Player Drive, Fort Collins, CO 80525, and Henry Hæikkinen, Dept. of Chemistry, University of Northern Colorado, Greeley, CO. 80639.

Understanding chemistry requires clearly recognizing the relationship between atomic structure and the properties of combined atoms. Current presentation can be improved greatly by stressing this relationship. This display review how the properties of atoms result from their electronic configurations. It then explains the advantages of a simple quantitative theory of polar covalence.

There are not two classes of compounds, covalent and ionic! Purely covalent bonds exist only between like atoms. In all compounds the electrons are unequally shared. This unequal sharing introduces partial charges on the atoms which (1) equalize the electronegativities, (2) determine the nature of each atomic contribution to the properties of the compound, and (3) substitute ionic contributions for part of the covalent energy. The illuminating type of cause-and-effect analysis that is now possible for hundreds of compounds is illustrated in detail by the example of sodium chloride.

419 ACTIVITIES FROM WONDERSCIENCE MAGAZINE. Ann E. Benbow, American Chemical Society, 1155 16th St., NW, Washington, DC 20036.

WonderScience magazine is produced as a joint venture of the American Chemical Society and the American Institute of Physics. The activities that will be demonstrated in the session are those that use household supplies and that encourage adults and children to work as teams in their investigations. Some of the activities that will be presented are "Mixable Unmixables", "Indicator Indi-Gator", "Static Elecfishity", "The Density Dilemma", and "Soak Those Sharks."

420 SAFETY AND LEGAL ISSUES ASSOCIATED WITH PRESENTING. James A. Kauffman, Laboratory Safety Workshop, Curry College, Milton, MA 02186.

421 PHYSICS AND PHYSICAL SCIENCE TEACHING: A MODEL FOR EXCELLENCE. D. A. Berry, Science Supervisor, Chattanooga Public Schools, 1161 W. 40th Street, Chattanooga, TN 37409. D.D. Long, R.L. Bowden, and T.G. Teates, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.

We are offering a two-year summer and academic-year program (1989-91) for the preparation of better qualified and more enthusiastic physics and physical science teachers. Twenty-one teachers from Virginia, southern West Virginia, and eastern Tennessee were selected on the basis of: 1) their need for improvement of physics background and potential to serve the science education needs of youth; and 2) their commitment to providing workshops to disseminate their resulting knowledge and skills gained to other teachers in their geographic regions. We will present a description of the program design and format, and measures of the participants' levels of satisfaction with the program.

(This work is supported by NSF Grant TPE-8855542.)

422 INSTITUTING CHANGE: PROGRAMS FOR ENHANCEMENT OF SCIENCE AND MATHEMATICS TEACHING. Carlo Parravano, Division of Natural Sciences, State University of New York, Purchase, NY 10577.

Since its founding in 1987, the Center for Mathematics and Science Education at SUNY Purchase has fostered collaboration among a broad base of constituents: school and college educators, community and governmental agencies, corporations, and foundations. Numerous programs involving teacher training, outreach, and student development have made significant progress in improving the effectiveness of science and mathematics education in the region. The cornerstone activity has been one-week summer institutes based on the concept of "teachers teaching teachers." Concurrent activities include a Research Opportunities Program, a laboratory safety and chemical disposal program involving 30 school districts, and programs for students intended to stimulate interest in science and mathematics. This presentation will provide an overview and evaluation of the Center's activities, plans for the future, and suggestions for replication. The programs are supported in part by NSF Grant No. TPE-8850973 and NYS Education Department, administrator of Title IIA Grants.

423 TEACHING ELEMENTARY PHYSICAL SCIENCE. Doris K. Kolb, A. Donald Glover, Chemistry Department, Bradley University, Peoria, IL 61625

A workshop on "Teaching Elementary Physical Science" was presented for thirty 3rd and 4th grade science teachers in the Peoria area during the spring of 1990. The all-day sessions were held on six consecutive Saturdays during the months of March and April. Seed money for the project was provided by the NSF through The Institute for Chemical Education, with further funding through a Title II Eisenhower grant. The content, format, and some special features of the program will be described.

424 ENHANCING 9TH GRADE GENERAL SCIENCE TEACHERS CHEMISTRY BACKGROUND. L. R. Summerlin and L. K. Krannich, Department of Chemistry, The University of Alabama at Birmingham, Birmingham, Alabama 35294.

Twenty-five Alabama physical science teachers were selected to participate in a year-long program of appropriate laboratory activities and discussions. From a large applicant pool, science teachers with no chemistry background were selected. Monthly sessions were built around general themes such as Chemistry of Atoms and Molecules, Chemical Reactions, Chemical Energy, Chemistry Around the House, Chemistry and the Environment, Chemistry of Living Things, Chemistry of Foods, Tools and Techniques of the Chemist, and Kitchen Chemistry. The format was unique but appropriate for this group. Each session began with a series of laboratory activities and demonstrations. Teachers wrote down questions that came up during their laboratory work, and these questions formed the basis for subsequent lecture discussions. Evaluations indicate a gain in knowledge and attitude.

425 CHEMSOURCE: A NEW SUPPORT STRATEGY FOR CHEMISTRY TEACHING. Mary Virginia Orna, Department of Chemistry, College of New Rochelle, New Rochelle, NY 10801

ChemSource is a new project, recently funded by the National Science Foundation, that originated in the Society Committee on Education of the American Chemical Society. The project intends to provide detailed support for inexperienced secondary school chemistry teachers (pre-service or inservice teachers in their first three years of chemistry teaching). The two major components that will be developed, tested and disseminated over the next three years are SourceBook and SourceView. SourceBook will contain specific teaching ideas and information gleaned from experienced, successful chemistry teachers related to over thirty curriculum topics. This support material, together with general perspectives on effective chemistry teaching and learning, will be available both on disk and in hard copy formats. SourceView will use video and other technologies to introduce inexperienced teachers to successful teaching strategies related to laboratory and classroom instruction and management (e.g., introducing concepts, leading effective discussion, questioning skills). Approximately two hours of videotaped sequences will be produced; the design of Hypercard stacks and videodisk production will also be discussed.

426 NSF PROGRAM IN TEACHER PREPARATION AND ENHANCEMENT. Ethel L. Schultz, DTPE/SEE, Rm 635 B, National Science Foundation, Washington, DC 20550

Since 1984, the Division of Teacher Preparation and Enhancement of the Directorate for Science and Engineering Education of the National Science Foundation has been active in seeding the chemical education community with a variety of projects, designed to improve science education from K-12. Projects involve the preservice of future teachers as well as inservice for practicing teachers. The evolution of programs and priorities will be discussed with emphasis on what the perceived needs are and how science education for our youth can and must be improved.

427 THE HISTORY OF THE CHEMISTRY SET. W. B. Jensen, Department of Chemistry, University of Cincinnati, Cincinnati, OH 45221

The talk will trace, by means of advertisements and photographs of actual sets, the evolution of the chemistry set from Göttling's portable laboratory kit of 1789 through some of the current brands marketed in the 1980's. The emphasis will be on American and British chemistry sets and on the changing origins of the manufacturers, ranging from apparatus and chemical supply houses, through druggists and toy and hobby companies.

428 **EXPERIMENTS IN CHEMISTRY SETS**, David A. Katz, Department of Chemistry, Community College of Philadelphia, 1700 Spring Garden Street, Philadelphia, PA 19130.

Many of us who grew up with chemistry sets recall the range of materials and experiments that kept us occupied for many hours. Perhaps we started with a small chemistry set and later moved to a larger one to gain additional chemicals and apparatus. Experiments such as water-into-wine introduced us to the fundamentals of acid-base chemistry; flame tests and borax bead tests introduced us to chemical analysis; formation of gases, color changes, and precipitates taught us about chemical changes; carbon dioxide, oxygen, hydrogen sulfide ("skunk gas") and chlorine ("green gas") taught us about gases (and odors); rock candy and crystal growing taught us about solids and crystal structure; and fire-writing, making fuses, and other experiments with oxidizers introduced us to rapid oxidation (and pyrotechnics). Although many of the experiments are unchanged, today's chemistry sets are quite different in both the apparatus and chemicals they supply. This paper will look at the contents of some chemistry sets along with the types of experiments that a budding young chemist can do.

429 CHEMISTRY SETS AND THE POPULARIZATION OF CHEMISTRY. David J. Rhees, American Philosophical Society, 105 S. 5th St., Philadelphia, PA 19106.

This paper will place the development of the modern chemistry set in the context of broader trends in the popularization of chemistry in America, beginning with World War I. Popularly known as the "chemists' war," because of the prominent use of chemistry in high explosives, poison gases, and synthetic dyes, the First World War stimulated new public interest in chemistry and the chemical industry. To capitalize on that interest, toy manufacturers such as A. C. Gilbert introduced the mass-marketed chemistry set. At the same time, the American Chemical Society, the Chemical Foundation, and leading chemical companies launched a mass media campaign of popular education. Together, these efforts helped to make the nation "chemistry conscious" during the interwar period.

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430 THE IMPACT OF CHEMISTRY SETS - ANECDOTES AND STATISTICS. George L. Gilbert, Denison University, Granville, OH 43023

Responses to a combination of a letter to the editor of Chemical and Engineering News concerning the impact of chemistry sets on career choices of chemists and a questionnaire sent to 500 members of the New York Section of the American Chemical Society comprise the input for this presentation.

A surprising amount of information was contained in the individual correspondence. An interpretation of these letters and the more statistically reliable questionnaire will be offered as it pertains to the past as possible future impact of chemistry sets on career choices in science.

431 Interactive Video Techniques for the Teaching of Chemistry. Stanley Smith and Loretta Jones, Department of Chemistry, University of Illinois, Urbana, IL 61801

Combining full motion analog video images with digital computer graphics on a single screen has made it possible to develop new types of instructional material. Further enhancement of the visual images is now possible by real time conversion of analog video to digitial form for further processing. Specific examples of these video techniques as applied to instructional material for general chemistry will be illustrated.

432 FT-NMR PROBLEMS: AN INNOVATIVE VIDEODISC-BASED INSTRUCTIONAL TOOL. Arlene A. Russell, Orville L.Chapman, Department of Chemistry, UCLA, Los Angeles, CA 90024-1569

FT-NMR PROBLEMS constitutes a unique database of FT-NMR spectra. Recorded on a videodisc, which is controlled by a computer, over 6000 spectra from 48 compounds are available at a student's fingertip. Complicated molecular formulas quickly give way to molecular structure when students analyze the proton-decoupled ^{13}C spectra to determine symmetry in the structure. After analyzing the $\{^{1}H\}^{13}C$ DEPT spectra to get the number of hydrogens on each carbon type, students can now explore the 2-dimensional spectra. The carbon-proton HETCOR spectrum shows which protons are on which carbons; the proton-COSY spectrum identifies the coupling between protons (usually more complicated than textbooks lead students to believe). Finally, students use ^{1}H spectra acquired on both 500-MHz and 200-MHz spectrometers for the integration of the protons. Within an hour students begin to recognize spectral patterns and solve structures as experts do. Students become engaged in problem solving using higher-order thinking skills. In the process they acquire a sophisticated understanding of how to elucidate chemical structure sing modern FT-NMR methods.

433 THE BIRTH OF A VIDEODISC ; King, Mike ; Minnesota Mining & Manufacturing 2642 Hewatt Road ; Snellville, GA 30278

The videodisc medium will be described. Production of the videodisc from videotape will be shown. The details peculiar to the videodisc medium will be discussed.

434 The Periodic Table Videodisc and Beyond; Banks, Alton J.; Southwest Texas State University; San Marcos, TX 78666

The Use of the Periodic Table Videodisc in the general chemistry classroom will be discussed. A survey of the use of videodiscs will be discussed as a way of predicting future uses of the medium.

435 STUDENTS TEACHING STUDENTS, A VARIATION OF COOPERATIVE EDUCATION, W. S. Vitori Elizabeth Forward Senior High School, Elizabeth, PA 15037

One of the major problems in science education in general, and in chemical education in particular, is that far too many students are afraid to attempt the more rigorous courses and they appear to be bored with their concept of science. The key to changing attitudes and building a life-long appreciation for the sciences must come early in a student's formal education; certainly before high school. With this in mind, a program has been created for elementary students showing how science can be fun and fascinating. Although the aim of this program is to do activities that will excite and motivate the young students, the scientific basis behind each activity is discussed and explained. All activities are coordinated by Senior High Advanced Placement Chemistry Students.

436 PACTS in Sacramento, L. Borer and L. Zarzana, Department of Chemistry, California State University, Sacramento, California 95819

For the past four years, science evenings have been held at various elementary schools and at the State University in Sacramento. These evenings for children and their parents in grades 4-6 are sponsored by PACTS, Parents and Children for Terrific Sciences. University professors and their students present various "hands on" experiments for the children and their parents to do together. Emphasis is placed on developing the scientific method of thinking skills.

Our most recent science evenings involve a series of six different experiments. Six instructors (senior chemistry and physics majors from the university) are in charge of the experiments. After 15-20 minutes, the participants move to a new experiment and by the end of the evening, they have done all six experiments and have had an opportunity to interact with each of the six instructors.

Suggested experiments and the mechanics of the science evenings will be discussed. Handouts will be available.

437 WORLD OF WONDER: THE CHEMISTRY OF METALS, James P. Deavor, Department of Chemistry, College of Charleston, Charleston, SC 29424

The Charleston County Parks and Recreation Commission has sponsored the World of Wonder Science Program for elementary school children. Class sizes are limited to twelve students with each required to bring a parent. A rotation of six weekend one-to-two hour programs exposes the participants to chemistry, biology, geology, marine biology, physics, and other topics led by area scientists and science educators.

The chemistry program described involves the chemistry of metals. The children hear the story of Ira Remsen, make a silver bottle, investigate the plating of silver on a copper wire and copper on an iron nail, examine ferromagnetism, and make a music maker from a lemon Cu/Zn battery and the insides of a musical greeting card. The concept of chemical vs. physical change is discussed along with the scientific method, safety, and the properties of metals. This is a hands-on experience with questions and discussion strongly encouraged.

438 THE OTHER END OF THE PIPELINE--PROMOTING CHILDRENS' INTEREST IN CHEMICAL INDUSTRY. Christie Borgford and Alan Marsden, Science Education Group, Dept. of Chemistry, University of York, York, YO1 5DD, England

Shortages of career chemists in the pipeline are being felt and are expected to increase. Academic and industrial chemists and chemical engineers can become involved with schools and/or teachers for the purpose of increasing the interest of elementary school and middle school age children in real situations faced by chemists. It is important for students and teachers to work with practicing chemists in various capacities so that stereotypes can be avoided. This symposium will consider programs of high interest chemical example in classrooms; models for working with teachers to increase their awareness of industry examples and career possibilities; and specific active-learning samples designed to teach science and to overcome stereotypes. British examples of industry/schools based projects will be presented.

439 OPERATION SMART - A PROGRAM TO ENCOURAGE EVERY GIRL IN SCIENCE, MATH AND RELEVANT TECHNOLOGY. C. L. McKenzie, International Business Machines, P. O. Box 2150, Atlanta, GA 30055 and C. T. Sears, Jr., Department of Chemistry, Georgia State University, Atlanta, GA 30303.

Operation SMART is being developed by Girls Clubs of America with support from the National Science Foundation, Carnegie Corporation of New York, The Ford Foundation and other foundations and businesses. The program was established because the jobs of today and tomorrow require a background in math and science. Research clearly indicates that many girls drop out of these critical fields while still in school, and cut off their options for most jobs that pay well, offer opportunity for advancement, and provide fulfillment and satisfaction.

Operation SMART, for girls aged 6-18, by its programs 1) makes math and science fun, 2) involves girls in hands-on, participatory experiences, 3) encourages predictions and risk-taking, 4) uses mistakes and failures as opportunities to learn what went wrong and why, 5) give girls an understanding of what scientists do and what it feels like to be a scientist, 6) offers girls opportunities to pursue their interests and become engaged in math, science and technology.

This paper provides details of the program and how you can become involved in your hometown.

440 ADOPT A CLASS - OUR EXPERIENCES AND IMPRESSIONS

J. L. Langton, McDill School, 2516 School, Stevens Point, WI 54481 S. M. Wright, Chemistry Department, University of Wisconsin - Stevens Point, Stevens Point, WI 54481

Can a sustained, year-long classroom visitation program have a positive affect on fifth grade students' attitudes toward science? To answer this question, outreach efforts were focused on the fifth grade at one particular elementary school. About twelve visits to that classroom were made. Impact and impressions of the program will be shared. Comparisons to more traditional outreach efforts will be made.

441 AN EXPERT SYSTEM FOR SOPHOMORES IN ORGANIC CHEMISTRY

By Joyce C. Brockwell, John H. Werner, Stephen J. Townsend and Nim H. Tea. Northwestern University, Department of Chemistry, 2145 Sheridan Road, Evanston, IL 60208

Much of the content at the beginning of a sophomore organic chemistry course is learning sets of descriptive rules: for drawing and naming structures, for counting electrons and drawing resonance structures, for determining absolute stereochemistry and drawing Newman projections, etc. Later success in learning complex reactions and mechanisms depends on students' learning these very simple concepts.

Application of a limiting set of rules to solving problems is the structural basis for expert systems. It follows that an expert system is one source for aid in learning the rules of organic chemistry. A student may ask the computer to solve problems which explore the rules in the system, demonstrating the limitations and interactions of the various rules.

We have developed such a computer 'expert' (Beaker©) and will discuss the rules which the system 'knows' and how a student may employ the system to learn elementary organic chemistry. Beaker is a very compact, fast program which operates on the Macintosh and is useful for learning nmr, structural isomers, and reactions and mechanisms as well as the simpler items listed above.

442

PROBLEM SOLVING IN CHEMISTRY VIA AN INTELLIGENT TUTORING SYSTEM

Zavaha Scherz, Department of Science Teaching, The Weizmann Institute of Science, Rehovot 76100, Israel

Educational Environment for Problem-Solving (EEPS) was devised to support the development of problem-solving strategies of high school students. EEPS consists of an expert that refers to a specific domain and manages three strategies for learning problem-solving (knowledge-acquisition, investigation and problem-solving-coaching) and of a student-model generator.

This study presents a specific application of EEPS in chemistry, which deals with the connection between the location of elements in the periodic table and their macroscopic properties with an insight to their microscopic origins. The system is designed to reason about properties of both elements and compounds and to identify unknown materials according to a given set of properties. It is also able to follow and to coach a learner in problem-solving tasks. Case study results of operating the system with individual students will be reported.

443 PREDICTING INORGANIC REACTIVITY: EXPERT SYSTEM. James P. Birk, Department of Chemistry, Arizona State University, Tempe, AZ 85287.

An expert system has been developed, using Prolog, to predict products of inorganic chemical reactions. The expert system was designed to model predictive approaches used by a number of chemists, using the simplest rules possible.

After one or two reactant formulas are input, they are parsed to determine the component elements, to recognize any significant polyatomic groups, and to assign oxidation numbers to the elements. This information, combined with a limited database, is used to place the reactants into classifications which will fire rules for various kinds of chemical reactions. The expert system can make predictions for combination reactions, decomposition reactions, single displacement reactions, double displacement reactions (including oxidation-reduction, acid-base and precipitation reactions), complex ion formation reactions and other reaction classes. Upon demand, the system can describe the rules used to predict reaction products. The program also provides access to the database used to make predictions.

444 CHEMPROF: AN INTELLIGENT TUTOR FOR GENERAL CHEMISTRY

Catherine Middlecamp and Arthur A. Eggert, Univ. of Wisconsin, Madison, WI 53706
Elizabeth Kean, Center for Curriculum and Instn, Univ. of Nebraska, Lincoln, NE 68588

CHEMPROF is an AI system designed to teach chemical literacy and problem solving. It can work with students in one of three modes: assessing their skills and suggesting a next step, instructing them in content area, or solving problems with them, either ones that they or CHEMPROF supplies. In essence, students can choose how they would like to interact with CHEMPROF, and then CHEMPROF adjusts its instructional flow accordingly. Thus, the primary goal of CHEMPROF is to provide individualized instruction. To accomplish this, CHEMPROF utilizes a tutor, a teaching knowledge base, problem-solving experts, a student model and a conversational interface.

The two modules of CHEMPROF currently in use well demonstrate the power of such a system, both for class instruction and for remediation on an individual basis. Topics of discussion will include the impact of CHEMPROF in a tutorial program for minority/disadvantaged students, avenues suggested by the data collected in the student models, and the availability of CHEMPROF's "tinkertoy" system for development.

445 A LITTLE EXPERT GOES A LONG, LONG WAY. John S. Martin and Edward V. Blackburn, Department of Chemistry, The University of Alberta, Edmonton, Alberta, Canada T6G 2G2.

An expert system doesn't need to know everything in the textbook. Like most of us, it only needs to know enough to stay ahead of the learner.

A useful small expert system understands a specific type of problem well enough to ask an unlimited number of different challenging questions about it. It also provides relevant intermediate data and templates of solution strategies, so that the programmer may construct enough of an intelligent tutor to provide apposite response for any requirements the student may have while engaged in solving the problems.

This presentation will be illustrated with a variety of small expert systems from computer lessons that have been used and well validated by hundreds of students. They are used to teach analysis of solution equilibrium, interpretation of titration curves, design of buffers, electrochemistry and chemical kinetics.

446 KC? DISCOVERER: A CHEMICAL MICROWORLD BASED ON ARTIFICIAL INTELLIGENCE, VIDEODISC, AND COMPUTER TECHNOLOGY. John W. Moore, University of Wisconsin-Madison, Madison, WI 53706, and Daniel Cabrol, University of Nice, France.

KC? Discoverer enables students to manipulate and observe a variety of chemical information and thereby encourages them to use the data to make deductions, support or contradict theories, and solve problems. The KC? Discoverer data base holds nearly fifty facts about 103 chemical elements and is coupled to a videodisc that contains images of the elements and their practical applications and sequences showing their reactions (if any) with air, water, acids, and base. A wide variety of problems that rely on these data can be assigned to students.

The program also includes an expert system designed to provide guidance to a student who is working on a specific problem. The Knowledgeable Counselor consists of a supervisor that keeps track of student commands and records the significant choices that have been made, an inference engine that uses a knowledge base (KB) to generate appropriate advice, and a user interface that allows the Counselor to ask questions and recognize answers. The KB embodies a teaching strategy and must be devised by an experienced teacher familiar with the subject matter. A separate KB Development Environment allows teachers to develop their own problems without learning a programming language.

447 SPREADSHEET ANALYSIS OF STUDENT LAB DATA. Paul A. Cauchon, Science Department, Canterbury School, New Milford, CT 06776

Among the many roles for computers in a chemistry laboratory, the use of spreadsheets for data organization and analysis is one of the most efficient. It involves a technique which is relatively simple to learn and inexpensive to implement. This presentation will show how to prepare and use an Appleworks spreadsheet for real-time processing of student lab data, resulting in more effective post-lab discussions as well as simplifying the task of evaluating student reports. The techniques to be demonstrated are readily applicable to a wide range of quantitative experiments with commonly available hardware and software.

448 SPREADSHEETS AND DATA BASE MANAGEMENT APPLICATIONS
Patricia C. Flath, Paul Smith's College, Box 45, Paul Smiths, NY 12970

Enable™, Lotus™, Multiplan™, dBase II and III™, what's this Jazz™ all about?!! Single purpose programs versus integrated software--which do I choose? Are any of these of value to the classroom chemistry teacher or are they only of value to the laboratory manager or administrator or business instructor?

This presentation involves applications of spreadsheets and data base management systems for the chemistry instructor and the classroom. Certainly the former is useful for gradebooks and the latter for inventory of laboratory chemicals, particularly relevant because of our chemical storage requirements. But, these systems can have value to a chemistry student, e.g., to calculate materials input and energy output in a chemical reaction, for analysis of the diversity of a biological sample, for analysis of GC data, for cataloguing chemical information for experiments and reports, for filing laboratory data and results. These and other applications will be explored.

449 USING DATABASE MANAGERS: AS EASY AS A-B-C. Larry M. Wier, Dept. of Chemistry, St. Bonaventure Univ., St. Bonaventure, NY 14778

Database management programs have not received as much attention and use in the chemical education community as have spreadsheets. This can be attributed to the high cost of the popular commercial database manager and the use of spreadsheets as database managers. However, in some cases, database managers can be a cheap, easy-to-use alternative to spreadsheets. To illustrate, chemical databases constructed with PC-File+, a shareware database manager, will be discussed.

450 SPREADSHEET CALCULATIONS IN GENERAL CHEMISTRY. G. L. Breneman and O. J. Parker, Department of Chemistry and Biochemistry, Eastern Washington University, Cheney, WA 99004.

Spreadsheet calculations for upper division chemistry courses have been described in the literature for several years. The ease with which they can be set up, the power they have in quickly showing changes in results by varying a parameter or two, and the ease of showing many results in graphical form make them ideal for use in General Chemistry. How these calculations are presented to the student and a number of useful examples including molecular weight, mole-gram conversion, atomic orbital plotting, chemical kinetics, ideal and non-ideal gas laws, and titration curves will be discussed.

451 VAULTING THE ARITHMETIC BARRIER IS AS EASY AS 123. Henry Freiser, Strategic Metals Recovery Research Facility, Department of Chemistry, University of Arizona, Tucson, Arizona 85721.

This talk describes a novel approach that makes the use of spreadsheet techniques an integral part of an entire course in analytical chemistry, which could serve as a model for other chemistry courses, as well as for other scientific, engineering and mathematical courses. The strategy of using a spreadsheet program can be stated very simply: Many problems of interest can be formulated in terms of one critical variable, one from which all, or mostly all, other relevant variables can be expressed. For example, in acid-base (A/B) equilibria, the critical variable is the pH; in complexometric titrations, the pM or pL; in countercurrent distribution (CCD), the plate or stage number; in chromatography, the HETP, etc. In all of these topics, achievement of a true blend of algebra and graphical display is readily achieved. Numerical results require no compromise and are obtained with no loss in rigor! This approach allows the student to produce and digest large assemblies of numerical data/calculations while still focusing mainly on the underlying principles governing the topic.

452 USING EQUATION SOLVERS, SPREADSHEETS, AND OTHER SOFTWARE WITH FRESHMEN LEARNING CHEMISTRY IN A NEW INTEGRATED ENGINEERING CURRICULUM. Allan L. Smith, Chemistry Department, Drexel University, Philadelphia, PA 19104

The Science and Engineering Education Directorate of the National Science Foundation awarded Drexel University's College of Engineering a large grant designed to help establish a new integrated curriculum (science, mathematics, writing, engineering fundamentals, engineering laboratory) for freshman engineering students. The project is called the Enhanced Educational Experience for Engineering Students (E^4). The E^4 curriculum was developed from January through August of 1989 by many Drexel faculty members from both science and engineering, and 100 Drexel freshmen were enrolled in the curriculum last fall. The chemistry component is contained in a large course entitled Mathematical and Scientific Foundations of Engineering. I will describe how Macintosh software was chosen for inclusion in the E^4 curriculum, and then describe how the students in the curriculum have been using an equation solver (TK Solver Plus), a spreadsheet (Excel), a laboratory data acquisition system (National Instruments' Labview), and a molecular graphics package (Molecular Editor). I will also discuss student use of an equation solver and a spreadsheet in the physical chemistry laboratory, particularly for the propagation of error calculation.

453 USING EQUATION SOLVING SOFTWARE TO SOLVE SIMULTANEOUS EQUATIONS AND TEACH MATHEMATICAL MODELLING IN THE UNDERGRADUATE CHEMISTRY CURRICULUM, William F. Coleman, Department of Chemistry, Wellesley College, Wellesley, MA 02181

A wide variety of chemical phenomena can be described by sets of simultaneous equations, sets of equations which are frequently non-linear. The difficulties involved in solving such sets of equations by hand has shaped the way that we teach many topics. For example, much of the difficulty that students encounter when dealing with complex equilibrium systems lies in determining the appropriate mathematical manipulations needed to simplify the simultaneous equations which describe the system of interest. The availability of high quality microcomputer software for solving such sets of equations makes it possible to focus attention on the chemistry of the systems rather than on the mathematics. This talk will describe the use of three software packages, MathCad, SEQS and MINSQ, to solve problems in thermodynamics, equilibrium, kinetics and quantum chemistry commonly encountered in the undergraduate curriculum. In addition this software makes it possible to have students explore the many different mathematical models of chemical behavior. Examples will be given from atmospheric chemistry where students are able to explore the effects on changing rate constants and adding additional reaction channels on the concentrations of important chemical species.

454 USING SPREADSHEETS TO SOLVE SCHRÖDINGER'S EQUATION. Frank Rioux, Department of Chemistry, St. John's U., Collegeville, MN 56321

A simple finite difference algorithm has been used to prepare LOTUS templates which yield numerical solutions to Schrödinger's equation for a wide variety of problems of interest to chemists and physicists. The graphics capability of LOTUS plays an integral role in obtaining and displaying the solutions. Short macros have been written so that a single template can be used in a large number of applications. For example, over twenty one-dimensional problems (particle in the box, harmonic oscillator, particle on a ring, etc.) have been solved with a single template. Another template has been prepared for fifteen applications (spherical potential well, hydrogen atom, Morse potential, etc.) which require solutions for the radial part of the three-dimensional Schrödinger equation. Basic programs written in the QuickBasic environment have also been prepared for all the problems.

455 USING SPREADSHEETS TO TEACH BIOCHEMISTRY. Sandra I. Lamb and Daniel E. Atkinson, Department of Chemistry, and Biochemistry, UCLA, Los Angeles, California 90024-1569

The principles of physical biochemistry are much more quickly understood if students are able to immediately observe how changes in different variables will influence an overall rate or equilibrium equation. Difficult topics such as enzyme kinetics, metabolism, membrane transport and stability of macromolecules are simplified when students learn how to quickly graph and manipulate data with computer simulations using electronic spreadsheet programs. Spreadsheets such as Visicalc (Apple) Supercalc, Quattro, Lotus 1-2-3, (IBM-PC) and Microsoft Excel (Apple Macintosh and Windows-IBM-PS/2) may be used to model various aspects of biochemistry. One of the outstanding advantages of any of the newer programs is their ability to prepare graphical representations of numerical data. Students quickly learn how to set up their own spreadsheets, to vary concentrations, etc. and see how these changes affect overall kinetics or transport phenomena. Several simple spreadsheets illustrating biochemical concepts will be demonstrated.

456 CHEMICAL COMPETITIONS. Margaret Christoph, St. Marks High School, Wilmington, DE, and Glenda Epperson, LaFayette High School, LaFayette, GA.

The organization and sponsoring of a Science Olympiad on three levels: elementary (grades 4, 5, 6); junior (grades 7, 8, 9); and senior (grades 10, 11, 12) will be discussed. Slides and a videotape of actual contests will be shown. Appropriate events for each level will be presented. Participants in the sessions will be invited to be contestants in selected events.

The Georgia Junior Academy of Science sponsors one of the most exciting academic competitions you will ever be acquainted with - the Science Bowl. The competition includes a written exam to seed the teams followed by head to head team competition in a single elimination tournament. Participate on a team and take home a round of questions to try with your students.

457 **SCIENCE FOR ALL**: FORGING THE FUTURE OF SCIENCE

Audrey B. Champagne
1920 L Street, NW
Washington, D.C. 20036

The goal of the American Association for the Advancement of Science's Project 2061 is to give direction to the reform of science education. The first phase of this national effort resulted in a report, **Science for All Americans**, which describes the knowledge, skills, and attitudes all students should retain after 13 years of school science.

The work of the second phase of the project is to develop curriculum frameworks to guide the nation's schools in the development of curricula to achieve the goals set forth in **Science for All Americans**. This work is being carried out in six school districts across the United States in cooperation with AAAS 2061 staff.

During the third phase of the project, school districts across the nation will use the framework most appropriate to their own situations to create science curricula to meet the expectations of their communities and needs of their students.

This presentation will describe in more detail the work of Project 2061 and its implications for the future of science education in the United States.

458 ENCOURAGING WOMEN TO ENTER AND REMAIN IN THE SCIENCES: PROACTIVE, UNIFIED EFFORTS.

Linda S. Dix, Office of Scientific and Engineering Personnel, National Academy of Sciences/National Research Council, Washington, D.C. 20418.

This paper provides an overview of the status of science education for girls and women, focusing on the following topics:

(1) Factors contributing to the underrepresentation of females in science and engineering --both within the education pipeline and as employees in those fields;
(2) Currently available data about the participation of females at various levels of the education pipeline, as well as their utilization in the scientific work force;
(3) Forces--for example, the changing U.S. demography and anticipated retirement of scientists and engineers employed in academe and industry--necessitating a more concerted effort to recruit and retain females to scientific careers;
(4) Successful interventions to achieve that goal; and
(5) The role of both federal agencies and professional societies in maintaining a stable S&E work force.

459 PRACTICE AND TEACHING OF SCIENCE TO STUDENTS OF ALL AGES.

Samuel Devons, Dept. of Physics, Columbia University, Nevis Laboratories, P. O. Box 137, Irvington, NY 10533

The relevance of the Haekel dictum, that "Ontogeny recapitulates phylogeny", to the development of individual scientific understanding and appreciation, will be discussed. Comments will be based on varied experience in the practice and teaching of science to students of many ages and levels of sophistication, from 'K' to 'age X'.

460 DISCUSSION OF ETHICS AND VALUES IN UNIVERSITY SCIENCE COURSES. Penny J. Gilmer* and Paul R. Elliott**, Dept. Chemistry* and Dept. Biological Science**, Florida State University, Tallahassee, FL 32306.

University science courses typically are driven by the ever growing content of science. This often leaves little or no time for discussion of ethical and values issues at the interfaces between science, technology and society. Five years ago we started a new approach at Florida State University in which we integrate ethical and values issues in an interdisciplinary science course.

In the first of three course sections, Facts & Fictions of Science & Scientists, we describe the pop culture view of scientists, followed by an overview of the scientific and technological enterprise, including its dimensions, its complexity, its composition, and its influence on society. Typical subtopics for the second section, Dilemmas for Modern Science & Technology, include: Radiation & Risk Assessment, New Reproductive Technologies, Science, Ethics & Public Policy in AIDS, and Atmospheric Changes on Our Earth. In the AIDS section, we integrate not only the biological aspects of this disease but also the legal, social, ethical and public policy issues. In our final section, Societal Impact on Science and Technology, we demonstrate how the society in which we live influences ongoing science and technology. Here we discuss science ethics, including issues such as misconduct in science and conflicts of interest.

461 PARTNERSHIP PROGRAMMING AND CREATIVE COALITIONS. Sylvia A. Ware, Director, Education Division, American Chemical Society, 1155 Sixteenth St. NW, Washington, DC 20036.

The ACS document, Education Policies for National Survival, summarizes the science education policy positions of the American Chemical Society. These policies address Society concerns at all levels of education from kindergarten through the continuing education of teachers. Many of the recommendations in this report are being addressed in a preliminary fashion by the education programs of the Society, whether these programs are located in the division of Chemical Education, the staff Education Division, or some other group. At their most successful, these programs involve partnerships between organizational units within the Society, as well as partnerships with other associations, chemical companies, institutes of higher education. The problems delineated in Eduction Policies for National Survival will only be solved if further cooperative activities are developed, especially with state departments of education. Individual efforts, if not coordinated, lead to entropy. The American Chemical Society, with the Triangle Coalition, has a key role to play in efforts to encourage the coordination of private sector initiatives on a state-by-state basis utilizing the expertise of the ACS local sections, ACS Corporation Associates.

462 TRAINING MINORITY TEACHERS. Frederick Humphries, President, Florida A&M University, Tallahassee, FL 32307.

463 TEACHERS TEACHING TEACHERS: NATIONAL CHEMISTRY WEEK ACTIVITIES. Daniel J. Antion, University of South Carolina, Columbia, South Carolina, 29208; M. Louise Floyd, Pelion High School, Pelion, South Carolina, 29123; and Sondra F. Wieland, Fort Mill High School, Fort Mill, South Carolina, 29715.

The South Carolina Section of the ACS and the South Carolina Association of Chemistry Teachers teamed up to conduct a series of statewide workshops to train elementary and middle school teachers with leadership potential to perform chemical demonstrations. Subsequent to the training, the lead teachers returned to their respective schools and school districts to in-service other teachers. This cooperative pilot program involved the efforts of colleges and universities, school districts, individual schools, chemical industries, and teachers and faculty at all educational levels. More than 1000 elementary, middle, and high school teachers as well as 50,000 students in grades K-12 were involved in the statewide program. TEACHERS TEACHING TEACHERS was organized, coordinated and conducted by 27 Master Chemistry Teachers in South Carolina.

464 EXPLORATIONS IN CHEMISTRY: TEACHERS TEACHING TEACHERS. Dianne M. Epp, East High School, 1000 So. 70th, Lincoln, NE 68510

Out of the conviction that the secondary chemistry teacher is in a unique position to help elementary teachers up-grade their understanding of science content, I share the workshop experience which I designed and implemented with a group of elementary teachers. It includes these emphases: 1. Teachers teaching teachers. Elementary teachers WANT to teach science but often feel inadequately prepared to answer questions they anticipate their students will ask. Secondary chemistry teachers can help them understand underlying content concepts. 2. Use of observation and laboratory activities to reinforce content concepts. Activities included in this workshop are ones which elementary teachers can take directly into their classrooms to support basic chemistry topics which are part of the elementary science curriculum.

465 HANDS ON SCIENCE ACTIVITIES. S.J. Baum, Department of Chemistry, SUNY Plattsburgh, Plattsburgh, NY 12901.

The demand for high quality, continuous science instruction in the elementary grades has never been greater. There is virtually unanimous agreement that an interest in science needs to be captured at an early age when a student's curiosity and motivation are taking shape. Young students must experience more "hands on" science activities if they are to develop the skills and motivation to pursue science at higher levels. However, before we can reach the elementary student, we must first adequately prepare our future teachers. This talk will discuss a new chemistry course for elementary education majors. It is activity-driven. The unique feature of the course is the constant interaction between the lecture material and the laboratory activities. In the laboratory, the elementary education majors will perform activities that they can duplicate in their classrooms after graduation. Included in this talk will be examples and demonstrations of laboratory activities that have been prepared for the course.

466 ELEMENTARY MATHEMATICS AND SCIENCE INSTITUTE: A SUCCESSFUL SUMMER PROGRAM INVOLVING THE COOPERATION OF SEVERAL ACADEMIC DEPARTMENTS; Jeffrey R. Pribyl, Mankato State University, Department of Chemistry, Mankato, MN 56001.

The Elementary Mathematics and Science Institute (EMSI) sponsored by the University of New Hampshire during the summer of 1989 brought together 21 elementary teachers and 10 university faculty members for six weeks of study in the areas of physical science, mathematics and pedagogy. Before EMSI began, the university faculty members from the Chemistry, Physics, Education, and Mathematics Departments participated in a three day workshop covering the topics of cognitive development, interactive classroom design, and concerns of the elementary teacher. These faculty members were responsible for the morning content sessions which were designed to strengthen the participants knowledge of mathematics and physical science. These faculty members were often present at the afternoon sessions which stressed pedagogy and application of science to the elementary classroom. This combined effort by several departments provided for a strong content presentation which was sensitive to the needs and fears of the elementary teacher. This paper will describe the format of EMSI and will discuss the workshop for faculty members.

467 *CHEMISTRY WORKSHOPS FOR ELEMENTARY TEACHERS.* *Gerald R. Franzen, Department of Chemistry, Thomas More College, Crestview Hills, KY 41017*

Workshops on "hands-on" activities were conducted for elementary teachers, grades K-6, with the assistance of a grant from the Institute for Chemical Education. Each workshop was composed of two Saturday morning sessions, one in the fall and one in the spring. In the fall workshops, each teacher tested each of ten activities with the appropriate written materials, physical supplies, laboratory time and guidance. These activities, both demonstrations and "hands-on" student activities, were chosen with the following considerations: 1) availability of written materials at the appropriate level, 2) safety, 3) applicability to science at the elementary school level, 4) ready availability of supplies and 5) short preparation time. The spring workshops followed the same general format and set of guidelines with the exception that several of the activities required slightly more sophisticated materials. In these cases, sufficient supplies to conduct each activity in the classroom were provided for the teacher.

468 LEARNING STYLES VS. ACHIEVEMENT IN CHEMISTRY: GRADE 13 William H. McMahan, Department of Chemistry, Miss. State Univ., Miss. State, MS 39762.

Learning styles have been determined for a large number of freshman chemistry students. Relationships between learning styles and achievement in freshman chemistry will be discussed. Strategies for utilization of these data to improve achievement will be presented.

469 USE OF THE LEARNING CYCLE TO PROMOTE COGNITIVE DEVELOPMENT. Mary Ann Davison, Departamento de Química, Universidad Interamericana de Puerto Rico, P.O. Box 1293, Hato Rey, Puerto Rico 00919. J.D. Herron, Chemistry Department, Purdue University, West Lafayette, IN 47907

In this study learning cycle format experiments were utilized in two experimental sections of General Chemistry I. The Group Assessment of Logical Thinking (GALT) and the Science Process Skills Test (TIPS II) were administered as pre and post tests to evaluate the effectiveness of the learning cycle experiments used to promote intellectual development. Students who used the learning cycle experiments outperformed a control group that used conventional laboratory experiments on TIPS II but not on the GALT. In order to obtain more specific information about the treatment effects comparisons were made between tne proportion of students in the control and experimental groups who answered each item on these tests correctly.

470 A GUIDED DESIGN PROBLEM-SOLVING LABORATORY PROGRAM. Patricia A. Metz, Department of Chemistry, Texas Tech University, Lubbock, TX 79409.

This past year, the traditional "cookbook" and "fill-in-the-blank" laboratory manual used in the honors general chemistry course at the University of Delaware was replaced with a guided design problem-solving laboratory program. This alternative approach to lab provides the students with an opportunity to carry out chemical investigations in a manner more indivative of real world science -- where the problems are often nebulous and a set of instructions nonexistent. The problem-solving format helps students learn to 1) identify the problem(s), 2) search resources for information, 3) design experimental procedures, 4) evaluate experimental results, 5) communicate their findings, and 6) develop group process skills. This talk is focused on the structure, development, implementation, and outcomes of this pilot project made possible through a grant from the Center for Teaching Effectiveness at the University of Delaware.

471 PROBLEM CATEGORIZATION--A LEARNING THEORY-BASED PROBLEM SOLVING APPROACH. Diane M. Bunce and Dorothy Gabel, Department of Chemistry, The Catholic University of America, Washington, D.C. 20064.

Problems that are found at the end of chapters in most chemistry textbooks (high school and college) do not offer enough variety to promote students' problem solving skills. As a result, students learn to solve problems in a rote fashion. When minor changes are made in the problem description, many students don't recognize the problem and thus are unable to solve it. This research demonstrates the power of teaching students to solve problems by categorizing them first and then engaging in a detailed plan to solve them. Categorization is stressed in one part of the EXPLICIT METHOD of Problem Solving which is a method of analyzing problems based on findings of cognitive psychology which was used in this study. Student interviews were conducted to help elaborate some of the statistical findings of the study.

472 CHEMISTRY PROBLEM SOLVING -- THE EXPLICIT METHOD. Diane M. Bunce
Department of Chemistry, The Catholic University of America, Washington, D.C. 20064.

Chemistry has a reputation among students as being a very difficult course. As a result, less than one-third of all eligible high school students nationwide, elect to take it. Those that do, often experience trouble with the problem solving involved in many chemistry topics.

Problem solving using mathematical applications and logic is especially important in the topics of mole determinations and stoichiometry problems. Many students just don't know how to go about solving these problems.

This study looks at the results of teaching students a method of problem solving called the EXPLICIT METHOD which was developed based upon the findings of cognitive psychology and learning theory to solve problems. Five high school teachers taught the EXPLICIT METHOD in one of their classes and compared its effectiveness to their normal teaching stoichiometry problem solving. The results of the statistical analysis show that once the teacher effect is controlled, the EXPLICIT METHOD results in statistically significant higher student problem solving achievement.

473 "ACTIVATION ENERGY AND CHEMISTRY LEARNING: ALTERNATIVE CONCEPTIONS OF STUDENT TEACHERS-IMPLICATIONS FOR SCIENCE INSTRUCTION". A. F. CACHAPUZ and I. P. MARTINS, University of Aveiro, 3800 AVEIRO - PORTUGAL

The goal of this study was to assess how 29 chemistry student teachers use the concept of energy of activation (Ea) to interpret usual school experiments. The study falls within the research on "alternative conceptions" and investigates an important concept for the training of chemistry teachers which has not received enough attention.
The sample was drawn from two Portuguese Universities involved in pre-service training. All subjects had already been involved in the teaching of chemistry (grades 8 to 11). Data was collected by means of interviews; tasks presented (paper and pencil) were partialy designed on the basis of previous results obtained by the authors with pupils of those grade levels.
Content analysis of interviews revealed several patterns of alternative conceptions, e. g., in the case of non-spontaneous reactions, Ea would contribute to its energetic balance (ΔH). The results further suggest an important role of language (e.g., the intrusion of familiar connotations of "spontaneous"). Implications for science instruction are presented.

474 UNDERSTANDING CHEMICAL EQUILIBRIUM. Robert B. Kozma, NCRIPTAL, University of Michigan, 2400 School of Education, Ann Arbor, MI 48109, Joel Russell, Department of Chemistry, Oakland University, Rochester, MI 48063, and Jerome Johnston, NCRIPTAL.

This study examines the range of conceptions and misconceptions that college students have about chemical equilibrium. Nineteen students from two institutions were selected from remedial, introductory, honors, and graduate chemistry courses. Analysis of performance on a range of qualitative and quantitative problems and think-aloud protocals resulted in two major patterns and several variant models. Inaccurate/ Incomplete understanding: 1) EQUALibrium Model. This misconception is based on the notion that equilibrium is a condition where reagents are "balanced" or "evened out." 2) Static End-State Model. With this misconception, students believe that when equilibrium is reached, the reaction stops. 3) Qualitative Model. This model accurately represents equilibrium as a dynamic state but does not include an understanding or use of the equilibrium constant. Accurate understanding: 1) Recent Master Model. This is an an accurate and relatively complete qualitative and quantitative understanding of chemical equilibrium. 2) Expert Model. Beyond the above model, experts distinguish themselves by expressing equilibrium in terms of its underlying thermodynamic properties.

475 APPLIED CHEMISTRY MISCONCEPTIONS THAT SURVIVE THE GENERAL CHEMISTRY COURSE.

John W. Judkins, Department of Chemistry and Chemical Engineering, Stevens Institute of Technology, Hoboken, NJ 07030.

The college level general chemistry course is taught to students with the hope that the knowledge will be used to understand and possibly exploit chemical phenomena observed in the real world. The literature and our research indicate that incorrect explanations of natural and man-made events, in other words misconceptions, often survive directly conflicting course instruction. This talk will present some of the persistent applied chemistry misconceptions that have been detected at Stevens and other colleges. Also discussed will be the implications of these persistent misconceptions and some of the remedial techniques that are currently being implemented and evaluated nationally and at Stevens.

476 THE FIVE HUNDRED HATS: DIRECTING THE GENERAL CHEMISTRY PROGRAM.

Patricia L. Samuel, Dept. of Chemistry, Boston University, 590 Commonwealth Avenue, Boston, MA 02215

Directors of general chemistry programs don't actually wear five hundred hats, but there are days when the position feels like that number is rapidly being approached! The director must act in many different capacities: advisor to students and TAs, interpreter of American customs, instrument troubleshooter, class scheduler, curriculum designer, demonstration inventor and coordinator, substitute registrar, textbook screener, labor negotiator, shoulder to cry on, teacher (and student), researcher, author, court of last resort. How to balance all these hats? Start with a good datebook and a sense of humor!

477 INTRODUCTION OF COMPUTER TECHNOLOGY INTO THE CHEMISTRY CLASSROOM/LABORATORY.

C. O. Zimmerman, H. A. Smith, Division of Science/Mathematics, Tallahassee Community College, Tallahassee, Florida 32304-2895

The availability of inexpensive, yet powerful, microcomputer technologies offers the chemistry instructor the possibility of incorporating a variety of learning experiences which would be otherwise too dangerous, time-consuming or expensive under traditional settings. Tallahassee Community College has received an NSF grant to implement such technologies into a model curriculum aimed at upgrading chemical laboratory science instruction at the freshman level. A sample of this curriculum involving periodic properties of the elements will be demonstrated using two complementary software packages: MacMendeleev - a graphical database of periodic properties, and the Periodic Table videodisc and hypercard stack - a multimedia data base of periodic properties. Emphasis will be placed on how such materials may be used directly or repurposed into lesson plans for individualized laboratory exploration. Such a curriculum provides a safe and effective means of maximizing student involvment as well accomodating individual learning styles.

478 USING A MOTOR TO DEMONSTRATE CONDUCTIVITY ON THE OVERHEAD

by Sally Solomon
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Philadelphia, PA 19104

Solutions to be tested are placed in a circuit consisting of a battery, electrodes, and a motor fitted with a propeller.

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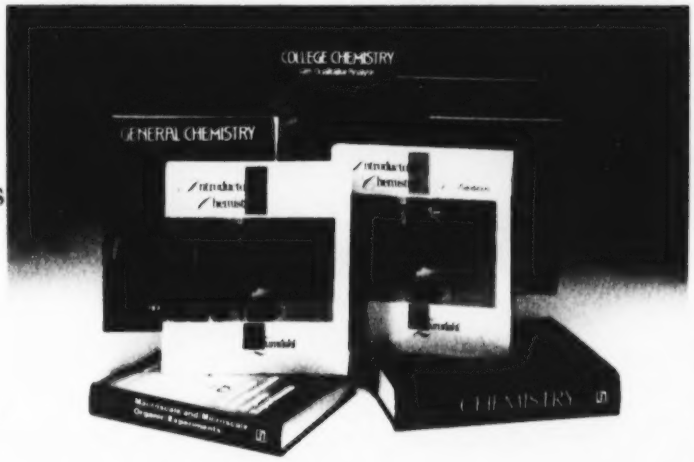

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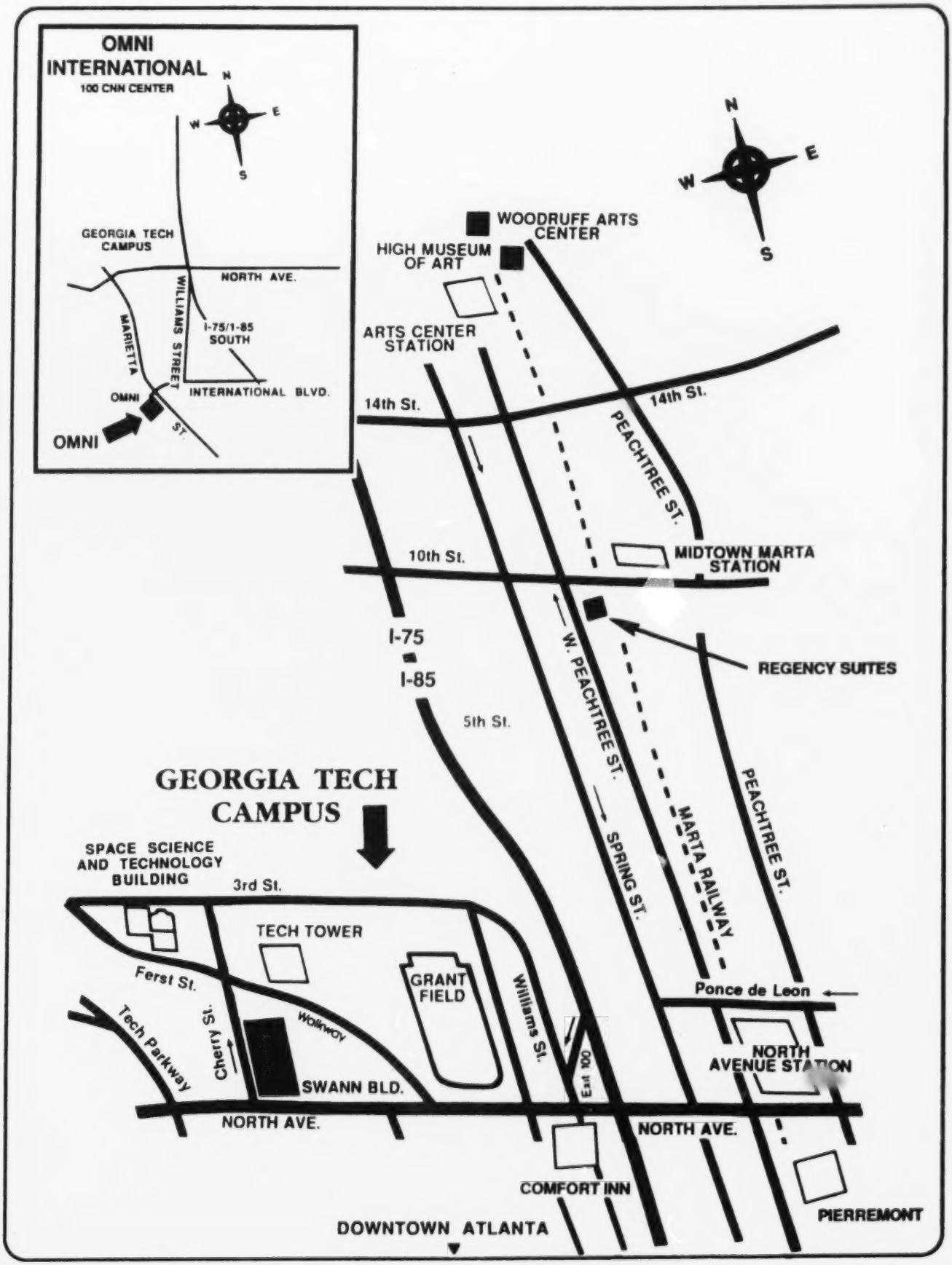
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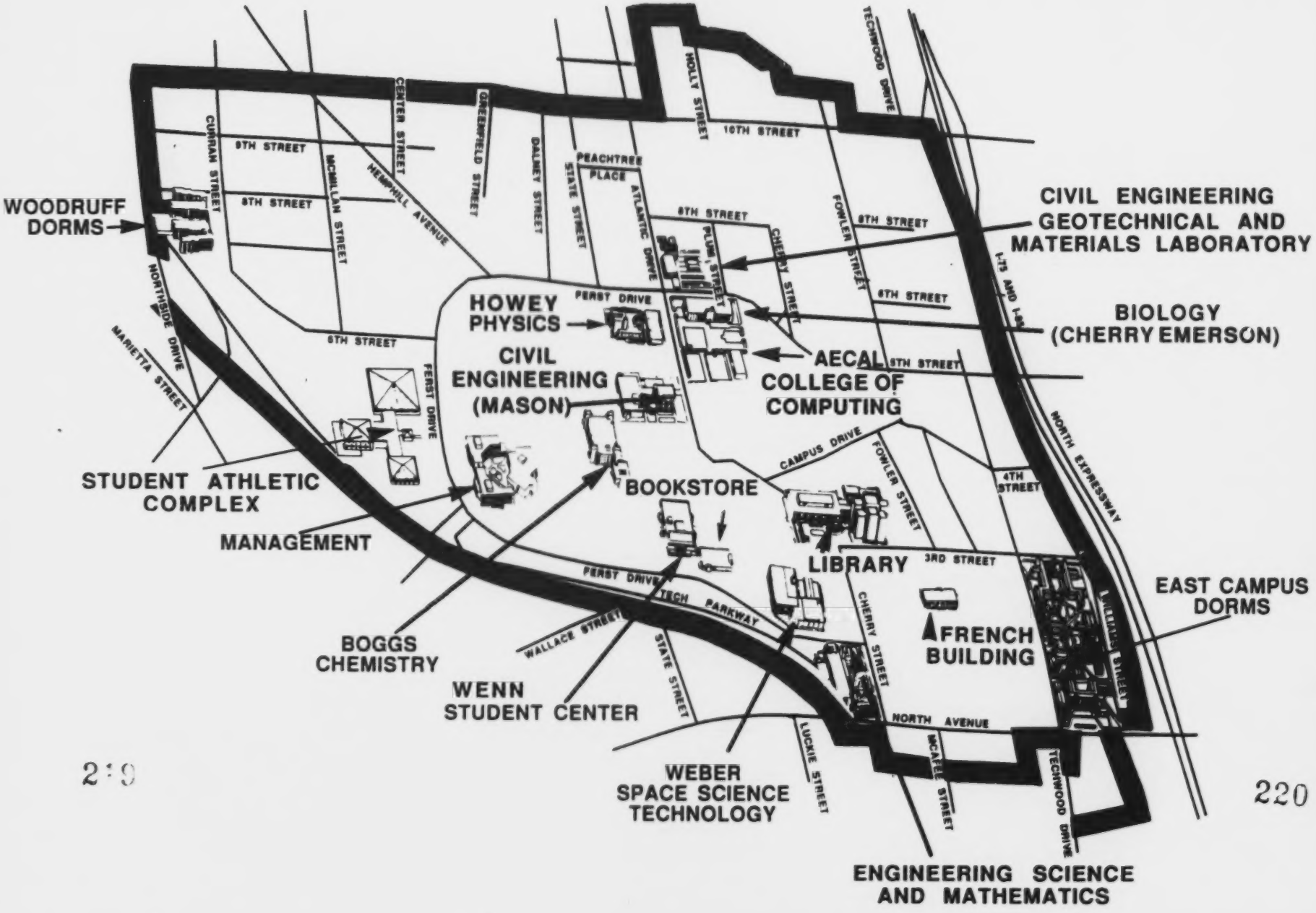
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